FORESTRY COMMITTEE

GREAT PLAINS AGRICULTURAL COUNCIL

ANNUAL MEETING

Living Snow Fences

Motivation

Woody Draws

Billings, Montana

July 11-14, 1983

PROCEEDINGS

THIRTY-FIFTH ANNUAL MEETING

GREAT PLAINS AGRICULTURAL COUNCIL - FORESTRY COMMITTEE

JULY 11 - 14, 1983

Prepared by

Division of Forestry

Montana Department of State Lands

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Thirty-fifth Annual Meeting
Great Plains Agricultural Council - Forestry Committee
July 11 - 14, 1983
Holiday Inn West, Billings, MT

MOTIVATION

MONDAY - JULY 11, 1983

9:00	Registration
1:30	Forestry Committee & Task Force Business Meetings (Concurrent)
3:00	Coffee Break
3:30	State Reports (Concurrent)
5:00	Adjourn
7:30	Great Plains-13 Committee Meeting & Pest Management Task Force Meeting (locations to be announced)

TUESDAY - JULY 12, 1983

JOINT RESEARCH FORUM MODERATOR - MARK HARRELL

8:00	Highlights on Research Progress - Glenn W. Peterson
8:10	Changes in Research Responsibilities at Research Unit in Lincoln - Glenn W. Peterson
8:20	Activities of Coop. State Research Service (Trends) - Wayne K. Murphy
8:45	Diseases of Siberian Elm and Russian Olive in Northern Great Plains - Dr. J. M. Krupinsky
9:10	Cankers of Honeylocusts - William Jacobi
9:25	Canker Rot Caused by Phellinus Punctatus on Woody Plants in North Dakota - James Walla
9:40	Hyadaphis tataricae, An Aphid Pest of Honeysuckle - Ackland Jones
9:55	COFFEE BREAK

MODERATOR - WALT PASICZNYK

10:20	Genetic Improvement of Trees & Shrubs in the Northern Great Plains - Dr. Richard Cunningham
10:45	MITOSIS--Montana Interagency Tree or Shrub Improvement Study - Bill Magnuson
11:00	Height Growth of Ponderosa Pine Seed Sources in Plains Plantations - Ralph A. Read

11:20	Ponderosa Pine Open-pollinated Progeny Test for the Great Plains - Richard M. Jeffers
11:30	Woody Habitats in SW No. Dakota - Michele M. Girard
12:00	LUNCH
	MODERATOR - ROBERT H. HEINTZ
1:00	Streambank Revegetation on Lower Yellowstone and Missouri River - Leon D. Logan
1:20	Conifer Seedling Establishment and Water Relation on Strip-mined Lands in Eastern Montana - Nan Vance
1:40	Fertilizer & Drip Irrigation Study - Thomas C. Hennessey
2:00	Living Snowfence - Doak Nickerson, Nebraska Living Snowfence - Ed Olmsted, Colorado Living Snowfence - Dan Perko, Wyoming
3:00	COFFEE BREAK
	MODERATOR - RICHARD A. CUNNINGHAM
3:30	Hybrid Poplar Cultivars in Black Hills - Ardell J. Bjugstad
3:50	Leafy Spurge--Woody Plant Potential Conflicts - Ardell J. Bjugstad
4:10	Electronic Pest Survey - Dan Williams
6:00	No Host Cocktails
7:30	Banquet--Roger Bergmeier, MC Awards Presentation - Dick Gavit Speaker - Charles Sundstrom Coordinator, NR&ED Topic: Natural Resources Development on Montana Tribal Lands
	WEDNESDAY - JULY 13, 1983 - TOUR - Hal Hunter, Cruise Director
8:00	Travel to Huntley, MT
8:30	Tour Huntley Agriculture Research Center, Tree & Shrub Development and Antique Farm Equipment Museum.
10:30	Travel to Bridger Plant Materials Center & LUNCH
12:30	Tour Plant Materials Center Tree & Shrub Development & GP-13 Juniper Program
2:30	Tour of Pryor Mountains Area Spruce Budworm Infestation, History, Geology, Archeological Sites & Ice Caves

5:30	Steak-Out (Barbeque)
6:45	Crow Tribal History Fireside Chat - Mar Dell Plainfeather, NPS
7:30	Return to Billings

THURSDAY - JULY 14, 1983

MOTIVATION SEMINAR

8:30	Motivating People - Bob Minor, Organization Management Specialist, USDA Forest Service, Denver, Colorado
10:00	COFFEE BREAK
10:30	Motivation Continued
12:00	LUNCHEON Brief Business Meeting
1:00	Motivation Continued
2:30	Landowner Targeting - Ervin Schuster, Economist, Forestry Sciences Lab, USDA Forest Service, Missoula, MT
3:00	COFFEE BREAK
3:15	Landowner Attitude Survey Results from Nebraska - James Brandle, Dept. of Forestry, Fish & Wildlife, U of Nebraska, Lincoln, NE
4:00	Critique, Summary & Last Chance Comments
	ADJOURN

GPAC-FORESTRY COMMITTEE - BUSINESS MEETING
July 11, 1983, Billings, Montana

AGENDA

Call to order - 35th Annual Meeting - Ripley
Introductions & announcements - Co-Chairmen Roger Bergmeier, Willis Heron
Approval of 1982 minutes - Cunningham
Treasurer's report - Cunningham
Committee appointments: Nominations, audit, resolutions - Ripley

Sub-Committee Reports

- Information and Education Committee - Heintz
- Newsletter Editor - Walterscheidt
- Historical Committee - Ripley for Hentz
- Wildlife Committee - Heintz
- GP-13 Committee - Tauer - Brief
- Awards Committee - Gavit
- Tree Planting Trends - Ripley for Clark
- Pest Management Task Force - Harrell

Administrative Advisor Report - Vetterling
GPAC Executive Secretary Report - Holmes
- Updating the "Membership and Functions of the GPAC and its Committees"
- Forestry Committee - Page 7 (1981 edition)

Old Business

- Mailing list process - Ripley
- Historical Subcommittee - Ripley for Hintz
  - Art Ferber assignment
  - Location of complete sets of Proceedings
  - Need New Mexico site for storage - contact Hintz for the set
  - Publish listing in 1983 Proceedings
- Response to tree improvement research resolutions - Ripley

New Business

- 1984 Annual Meeting - South Dakota (tree improvement and seed collection workshop) - Helwig
- 1985 Annual meeting - Oklahoma - Craighead
- Funding requests -
  - National Arbor Day Foundation grant $300.00 - Ripley
  - "Tree Planting Handbook for the Dakotas" fund request - Cunningham
  - Fund donation to Montana for '83 meeting - do we continue in future? - Cunningham
  - Forest Pest Handbook funding request - Peterson
- Nominations Committee report
- Audit Committee report
- Resolutions Committee report
  - Oklahoma resolutions - Hull
  - Others

Announcements
Closing remarks - Ripley
Introduction of new Chairman Richard Gavit - Ripley
Adjourn

Minutes of Meeting
Great Plains Agricultural Council, Forestry Committee
Business Meeting, Monday, July 11, 1983
Billings, Montana

The meeting was convened at 1:30 pm by Chairman Bill Ripley. Attention was called to the minutes of the June 24, 1982 meeting as published in the proceedings. Walt Pasicznyk moved that the minutes be approved as distributed, Bob Heintz seconded, and the motion carried.

Treasurer's Report

Secretary-Treasurer Richard Cunningham reported a current balance of $6,754.02. Gil Fechner moved, Bob Heintz seconded, to approve the Treasurer's report as presented. Motion carried. A copy of the Treasurer's report is attached.

Newsletter Report

Bob Heintz reported that the current newsletter editor, Mike Walterscheidt, has one year remaining in his appointment as editor. Bob is open for suggestions or volunteers for the new editor to be selected at the 1984 meeting. Bob cautioned the members that the cost of mailing the newsletter was becoming very expensive and suggested that each state contact person review their mailing list and purge names of people not interested in receiving the newsletter.

Wildlife Committee

Bob Heintz reported that he has not yet had the opportunity to meet with the GPAC Wildlife Committee. Bob explained that North Dakota State University is hiring an Extension Wildlife Specialist who would likely have the responsibility for the Wildlife Committee rather than himself. Bob mentioned that the Wildlife Committee had produced a pest management booklet that was based on one developed in Kansas.

GP-13 Technical Committee

Chuck Tauer reported that he had assumed the chairmanship of the committee with the resignation of the current chairman, Jim Fisher. The annual meeting of the GP-13 Technical Committee was held July 11, 1983. A copy of the minutes of that meeting and a copy of the Committee's revised by-laws are attached.

Awards Committee

Dick Gavit reported that the Awards Committee had selected two recipients of awards and that they would be presented at the banquet. Recipients of the awards are Dr. Glenn Peterson, Nebraska and Mr. Robert Heintz, North Dakota. A more complete description of the awards is attached.

Tree Planting Trends

Chairman Bill Ripley reported for Bill Clark, chairman of the committee, that no report had yet been prepared. Ripley indicated that he would encourage Clark to prepare the report in time for inclusion in the proceedings.

Administrative Advisor Report

Dr. John Vetterling explained that this was the first Forestry Committee meeting he had been able to attend and briefly reviewed his education and background in forestry, wildlife management, veterinary science and agricultural research. John emphasized the need to update the list of official members of the Forestry Committee. He also pointed out the need for a one page summary of the minutes of the business meeting for Wendall Holmes to present at the Great Plains Agricultural Council meeting.

Old Business:

Mailing List Update

Chairman Ripley proposed the following procedure for updating the Forestry Committee mailing list:

1. Immediate past host forwards their mailing list to the secretary-treasurer. Secretary-treasurer gives copy to new host.

2. New host distributes copies to state representatives requesting an update (corrections, additions, deletions).

3. New host collects results and prepares an updated listing to be used for the next meeting. Furnish a copy to the secretary-treasurer.

4. Secretary-treasurer repeats cycle by forwarding the listing to the next host.

After discussion, and a lack of any objections, Chairman Ripley indicated that this procedure would be followed in the future.

Historical Committee

Chairman Ripley reported for Dave Hintz, a member of the Historical Committee. A copy of Hintz's report is attached. Bill reported that in a telephone conversation with him, Dave suggested that we consider asking someone else to complete the history since he doubted Art Ferber would be able to complete it. Bill suggested that the members consider the possibility of relieving Art of his obligation to complete the Historical Project and that we ask someone else to complete the project. Bill deferred action on this proposal until the reconvened business meeting scheduled for Wednesday.

Bill referred to Dave's report and the fact that a complete set of proceedings are now located at a permanent site in each state except New Mexico. Efforts are continuing to find a suitable site in New Mexico. Bill recommended that the proceedings of each annual meeting should contain a list of the locations of complete sets of proceedings for each state. This list should be a permanent feature of the proceedings.

Response to Tree Improvement Research Resolutions

Chairman Ripley reported that at the last meeting we passed three resolutions expressing our concern about recent cutbacks on the part of Federal and State agencies and land grant institutions in Great Plains tree improvement research. These resolutions were forwarded to all Experiment Station Directors, Deans of Agricultural Colleges, Directors of Forest and Range Experiment Stations, and other member agencies.

Some responses were received. Most supported the need for continuing tree improvement research in the Great Plains areas, but details on what actions might be taken were vague.

Responses were received from: CSRS - WO
SCS - KS
FMHA - NM
OSU - Department of Forestry
USFS - R-2 and R-3

National Arbor Day Foundation Grant

Last December the National Arbor Day Foundation (John Rosenow) contacted Chairman Ripley requesting a financial donation to help in the distribution of public service announcements promoting windbreaks in the Great Plains area. After consultation with members of the Executive Committee and our Administrative Advisor, it was agreed to grant the Foundation $300. This was done in June. The Foundation has acknowledged receipt with thanks. Distribution of the public service announcements has started.

New Business:

1984 Annual Meeting

Larry Helwig invited the Forestry Committee to hold its 1984 annual meeting in South Dakota. Tree improvement is the tentative theme and Watertown is the tentative site. Dick Jeffers moved, and Tom Warner seconded, we accept South Dakota's invitation. Motion carried.

Funding Requests

Chairman Ripley reported that in addition to the National Arbor Day Foundation's request for funding, two additional requests for funds had been received. Bill asked spokesmen for each request to briefly describe their funding proposal.

Rich Cunningham reported for Lee Hinds of North Dakota that the Tree Planting Handbook for the Dakotas was being revised and that financial assistance was needed in reproducing the color plates and in obtaining new plates for some species. No specific dollar amount had been computed.

Glenn Peterson reported for the Pest Management Task Force that the Tree Disease Handbook was nearing completion. Thirty-one of the 35 chapters have been sent to the editor. At least 32 people are contributing to the chapters. Probable publication date is 1985. At least 3,000 copies will be printed. Estimated cost of publication is $27,000. Glenn asked for help from Forestry Committee in soliciting funds from other sources to finance the handbook.

Chairman Ripley deferred action on these proposals until the reconvened business meeting on Wednesday.

Dick Gavit moved and Roger Bergmeier seconded to recess the meeting until Wednesday. Motion carried.

Chairman Ripley recessed the meeting at 2:48 p.m. Chairman Ripley reconvened the meeting on July 13, 1983 at 1:15 p.m. at the Bridger Plant Materials Center.

1985 Meeting

Chairman Ripley read a letter he had received from the Governor of Oklahoma in which the Governor formally invited the Forestry Committee to hold its 1985 annual meeting in Oklahoma. The proposed theme would be historical and would center around the observance of the 50th anniversary of the planting of the first Great Plains Forestry Project shelterbelt near Magnum, Oklahoma.

Max Craighead described Oklahoma's proposal and indicated that they would be striving for considerable national publicity for the event. Max asked that a steering committee be formed to help plan for the meeting and that each state have a representative on the steering committee.

Bob Heintz moved, and Phil Hoefer seconded to accept Oklahoma's invitation. Motion carried.

History of the Forestry Committee

Gil Gechner moved, and Bill Lovett seconded, that Ralph Read be asked to complete the historical project and that he be provided a stipend to help cover secretarial services. Motion carried. Roger Bergmeier moved, and Larry Helwig seconded that the Executive Committee be authorized to determine the amount of the stipend. Motion carried.

Executive Secretary's Report

O. Wendell Holmes greeted the members and reiterated the need to update the membership list. Wendell asked for help from the Executive Committee and other members. John Vetterling volunteered to poll the GPAC member agencies and institutions for an updated designation of each agency's official representative.

Audit Committee

Marv Strachan reported that he and Bill Lovett had examined the Treasurer's books and found everything to be in order. Marv moved, and Bill Lovett seconded, to accept the Treasurer's report. Motion carried.

Nominations Committee Report

Bob Fewin reported that the Nominations Committee composed of Larry Helwig, Bill Loucks, Gil Fechner and himself were nominating Norm Baer and Keith Lynch as candidates for the office of Secretary-Treasurer. There were no additional nominations from the floor. A vote was conducted by written ballot and Chairman Ripley declared Keith Lynch the winner and Secretary-Treasurer for 1983-1984.

Resolutions Committee

Roger Steward, Oklahoma, presented resolution #1. Bill Ripley asked who the intended recipients of the resolution were. Max Craighead suggested that it be sent to all of the appropriate research agencies and institutions in the Southern Great Plains. Marv Strachan moved, and Dick Jeffers seconded, that resolution #1 be approved. Motion carried.

Resolution #1 - Support for Research Needs in the Southern Great Plains:

WHEREAS, trees, shelterbelts, windbreaks and farm woodlots are a vital and necessary part of farm life in the Southern Great Plains, and

WHEREAS, the Southern Great Plains Agricultural Research Station, in Woodward, Oklahoma, was established in 1913-1914 as a research center for agriculture in the region, including research in farm beautification, windbreaks and shelterbelts, tree species traits, and horticulture, and

WHEREAS, research initiated in tree and shrub adaptability and use for the region in the period of 1934 to 1964 by Ernest Johnson, still exists today, incomplete in many instances, in a rapidly deteriorating state, and

WHEREAS, there is need for tree improvement research to select and breed trees better suited for planting in the hostile Southern Great Plains environment, and

WHEREAS, research being done in other parts of the Great Plains does not apply to the Southern Great Plains due to differences in precipitation, temperature and soil patterns,

NOW THEREFORE, be it resolved that the Great Plains Agricultural Council Forestry Committee actively support an increased commitment by federal and state agencies and land grant institutions toward the continuation of existing research and/or initiation of new research in tree improvement, Plains forestry, and/or horticulture in the Southern Great Plains.

Resolution written by Patrick A. McDowell and Donna J. Hull, foresters of the Oklahoma Forestry Division.

Resolution #2:

WHEREAS, the 35th Annual Meeting of the Great Plains Agricultural Council Forestry Committee was held in Billings, Montana, July 11-14, 1983, and

WHEREAS, we were all treated to excellent meeting facilities, well prepared speakers and informative presentations, topped off with mouthwatering steaks for two nights in a row, and

WHEREAS, we were given a rerun of the "good old days" by viewing walking plows, freynos, and Ruth Dredgers, and

WHEREAS, we rode all day to reach an elevation of 8,000 feet so we could walk back down 5,000 feet to the Big Ice Box, we learned to listen for tinkling bells when kicking bear scat, we were told by Mar Dell Plainfeather that General Custer was maybe not quite the nasty little fellow with the curly locks that we had always believed, and

WHEREAS, Helen Murray with her excellent organization and contagious laughter added sparkle and enjoyment to our Big Sky experience,

NOW THEREFORE, be it resolved that Roger Bergmeier, Willis Heron, Mark Herrell, Hal Hunter, Larry Holzworth, Roy Linn and Paul Moore, with Helen's direction and assistance, be commended and applauded for planning and conducting an excellent meeting for the Great Plains Agricultural Council's Forestry Committee.

Resolution written by Robert Heintz and Max Craighead.

Funding Requests

Rich Cunningham suggested that the Forestry Committee needed to develop a policy concerning the criteria by which funding requests should be judged and approved. Marv Strahan also voiced support for the development of such a policy. Chairman Ripley suggested that the new Executive Committee appoint a committee to establish such a policy and to have a report prepared by the next annual meeting.

Glenn Peterson again discussed the Tree Disease Handbook. It was proposed that a letter of description be developed that could be used in soliciting funds. Glenn said that such a letter was being written. Bob Heintz moved and Gil Fechner seconded, that a committee be named to help solicit funds for publishing the handbook. Motion carried.

Chairman Ripley discussed the granting of funds to the host state to use as a working capital fund to cover the expenses incurred before registration had occurred. Norm Baer moved, and Roger Bergmeier seconded, that this practice be approved as a permanent funding policy. Motion carried.

Commemorative Stamp

Bill Loucks proposed that the Forestry Committee petition the U. S. Postal Service to issue a postage stamp to commemorate the 50th anniversary of the first Great Plains Forestry Project shelterbelt planting. It was emphasized that the success of such an effort would require intensive lobbying efforts by all Forestry Committee members. Enlisting the support of Congressmen is crucial to gaining approval by the Postal Service.

Bill Loucks moved and Dan Perko seconded, that a committee of himself, Max Craighead, and Dick Gavit be appointed to coordinate this effort. Motion carried.

Chairman Ripleys Concluded Remarks

About a year ago, Administrative Advisor John Vetterling received a letter from a past Forestry Committee member that was critical of the way our annual meetings have grown in attendance. John asked several of us for advice on how to reply.

In responding to John's request, I was forced to closely examine my thoughts on the value of the GPAC-Forestry Committee, and I'd like to share these with you.

- The Forestry Committee serves a vital function in providing a medium for plains foresters to periodically assemble to exchange new ideas, identify problems and seek solutions, maintain interpersonal contacts between educators, researchers, field and extension foresters, and most importantly, the mix among such people. Moreover, the Forestry Committee is the only Great Plains organization to provide this opportunity.

- Meeting attendance and committee participation are voluntary. People will attend, and our employing agencies will continue to pay our way only if there are benefits in doing so. Our annual meetings, workshops, et. al. must continue to offer something of high value to sustain this interest. We've been successful for 35 years. Let's continue this success in the years ahead.

Chairman Ripley turned the gavel over to incoming Chairman Dick Gavit.

Chairman Gavit named an Awards Committee of Rich Cunnningham, Bill Loucks, Ed Holcombe and Marv Strachan.

On behalf of the entire group, Bob Heintz congratulated Bill Ripley on the fine job he had done as Chairman and led the group in a round of applause for Bill.

Roger Bergmeier moved, and Bill Loucks seconded, to adjourn the meeting.

Chairman Gavit adjourned the meeting at 2:00 p.m.

Respectfully submitted,

RICHARD A. CUNNINGHAM
Secretary-Treasurer

TREASURER'S REPORT
Forestry Committee, Great Plains Agricultural Council
Annual Meeting, July 11-14, 1983
Billings, Montana

BALANCE:	As of February 22, 1983 Received from Richard J. Gavit Treasurer, 1982	$7,606.87
INCOME:	2/24/83 - Interest on Money Market Checking Account Dakota Northwest Bank, Bismarck, ND	1.09
	3/23/83 " "	39.54
	4/26/83 " "	49.65
	5/27/83 " "	41.09
	6/24/83 " "	40.78
	Total Income	$ 172.15
SUBTOTAL:	Starting balance plus income	$7,779.02
EXPENDITURES:		
	3/28/83 - Mike Walterscheidt, Texas - newsletter	125.00
	5/23/83 - GPAC, Forestry Committee, Montana - Annual Meeting grant	500.00
	6/3/83 - National Arbor Day Foundation - promotional TV spot	300.00
	6/27/83- Mike Walterscheidt, Texas - newsletter	100.00
	Total Expenses	$1,025.00
CURRENT BALANCE:	As of 7/5/83	$6,754.02

Remarks: Funds are maintained in one money market checking account at the Northwest Bank, 4th St. & Broadway
P. O. Box 1538
Bismarck, ND 58501

Account requires $2,500 or more for highest interest rate.
Balance between $900-2,499 yields 5.25% interest.
Balance below $900 is charged $9/month service charge.
Account is currently receiving interest rate of about 7.0%

Richard A. Cunningham
Treasurer, 1983

Annual Meeting

GP-13 Committee

July 11, 1983
Billings, Montana

AGENDA

Welcome and Introductions -	Tauer
Annual Report -	Tauer
Minutes of 1982 Meeting -	Tauer
GP-13 By-laws -	Jeffers
Current Chairmanship status -	Tauer
Summary of State tree improvement needs and planting trends -	Jeffers
Species Progress Reports	
Ponderosa Pine - 10 year results -	Ralph Read
Juniperus -	Glen Peterson
Hackberry -	Rich Cunningham
New Ponderosa Pine Collection Plans -	Jeffers
Other Old Business	
New Business	
Election of GP-13 Secretary	
ADJOURN	

Minutes of Meeting
GP-13 Technical Committee

Date: July 11, 1983

Attendees: J. Cook. K. Ticknor, W. Lovett, W. Heron, J. Vetterling, W. Ripley, L. Helwig, G. Howe, K. Lynch, W. Loucks, N. Baer, W. Holms, R. Gilmore, J. Berst, M. Strahan, D. Perko, R. Read, R. Cunningham, L. Holzworth, H. Hunter, D. Jeffers, G. Fechner, C. Tauer.

The meeting was called to order at 7:45 p.m. by Acting Chairman Tauer at the Holiday Inn West in Billings, Montana.

Charles Tauer announced that he was presently Acting Chairman due to the resignation of James Fisher.

The minutes of the 1982 meeting were accepted as corrected. The correction to the minutes was that only one GP-13 Juniperus plantation was plowed under in South Dakota.

Jeffers presented the GP-13 By-laws as proposed at the 1982 meeting. Discussion followed with several changes being made. It was determined that two mailing lists would be maintained, one of participating agencies and the other of interested cooperating individuals. The By-laws were approved as amended. Charles Tauer became Chairman with the approval of the By-laws. Tauer will serve one year as Chairman to finish the term started by Fisher.

Jeffers reported on tree planting trends. It was noted that the number of conifers planted has steadily increased from 1970 to 1980 and the percentage of conifers, broadleafs and shrubs planted has stayed relatively constant.

Jeffers reported on a survey made of the tree and shrub improvement needs of the states. The greatest interest was in bur oak, green ash, Russian olive and Siberian elm improvement.

Read gave a brief report on the 10 year results of the ponderosa pine project of the Rocky Mountain Forest and Range Experiment Station.

Cunningham reported on the status of the GP-13 Hackberry study. Fifty-eight of the 275 collections have been made. This appears to be a good seed year, so it is hoped that most of the collections can be made this fall.

Peterson reported on the status of the Juniperus study. A call was made for the 5th year measurements to be taken in the fall of 1984. Dave Van Haverbeke will formulate a data collection sheet to be sent to all cooperators.

Jeffers reported on a new ponderosa pine project. The project will consist of making single tree seed collections from areas that are showing superiority in the study reported on by Reed. The resulting seedlings will be planted in such a configuration that the planting may later be turned into seed orchards. It was moved and seconded that this project be an official GP-13 project. The motion passed.

William Lovett was elected Secretary of the GP-13 Technical Committee effective July 11, 1983 and will serve for one year. The election of a new Secretary will be held at the 1984 meeting as stated in the By-laws.

The meeting was adjourned at 9:45 p.m.

Respectfully submitted,

William R. Lovett

BY-LAWS OF THE GP-13 TECHNICAL COMMITTEE

"IMPROVED TREES AND SHRUBS FOR PLANTING ON THE GREAT PLAINS"

Article 1. NAME

The name of this Technical Committee of the Great Plains Agricultural Council shall be known as GP-13 "Improved Trees and Shrubs for Planting on the Great Plains"

Article 2. OBJECTIVE

To conduct research on the improvement of trees and shrubs for the Great Plains.

Article 3. COOPERATING AGENCIES

Agencies participating in this GP-13 cooperative regional project are listed in Table 1 as amended annually.

Article 4. EXECUTIVE COMMITTEE

The Executive Committee shall be responsible for providing general direction and guidance to the GP-13 Technical Committee. It shall consist of the following individuals:

1. Administrative Advisor, GP-13 Committee
2. Chairman, GP-13 Committee
3. Secretary, GP-13 Committee
4. Immediate Past Chairman, GP-13 Committee
5. Forestry Committee, GPAC, Representative

Article 5. OFFICERS

Officers of the GP-13 Technical Committee shall be: (1) Chairman and (2) Secretary. Only GP-13 cooperating agency representatives shall be eligible for election as officers.

(1) The Chairman shall (a) preside at business and technical meetings of the Committee, (b) be responsible for arrangements for meetings, (c) appoint nominating and other special committees, (d) prepare annual committee report, and (e) act as Chairman of Executive Committee.

(2) The Secretary shall (a) keep the minutes of the Committee, (b) maintain a current mailing list of cooperating agency members, (c) conduct Committee correspondence with representatives, (d) announce meetings, (e) act as custodian of Committee records, (f) provide copies of annual report at annual meeting, (g) in the absence of the Chairman, preside at Committee meetings, (h) assist the Chairman in conducting Committee affairs as requested by the Chairman, and (i) maintain a list of participating agencies to be updated annually.

The term of duty for both officers shall be two years. The Secretary will assume the position as Chairman upon completion of a two-year term as Secretary. If the Chairman is unable to complete a full two-year term of office, the Secretary will assume the position of Chairman.

Article 6. ELECTION OF SECRETARY

Nominations for position as Secretary will be made by a Nominations Committee appointed by the Chairman. Additional nominations may be made by agency representatives at any time prior to election. The Secretary will be elected by attendees at the annual business meeting held in each even-numbered calendar year. Terms of office begin immediately after close of the meeting at which elections are held.

Article 7. MEETINGS

Annual meetings will be held in conjunction with the annual meetings of the Forestry Committee, GPAC. Arrangements for and conduct of the annual meeting will be the responsibility of the Committee officers. Additional meetings may be held at the discretion of the Committee officers.

Article 8. QUORUM

Ten GP-13 Committee members shall constitute a quorum for the conduct of business at the annual meeting.

Article 9. SPECIES WORKING GROUPS

Cooperating agencies conducting research on a species being researched by the GP-13 Committee will constitute a Working Group for the species. Agencies working on more than one cooperative species project will be members of each species working group. Members of each Working Group will select a Working Group Coordinator. Each Working Group will prepare a Regional Project Work Plan for approval by the Research Committee, GPAC. Annual progress reports will be presented by each Working Group at the annual business meeting.

Article 10. AMENDMENTS

Amendments to these By-laws may be proposed in writing by any Committee member to the Secretary not less than five months before an annual meeting. Proposed amendments shall be included in notices of meetings, and may be adopted by a favorable vote of the majority of the GP-13 members present and voting at the time of the meeting.

TABLE I - COOPERATING AGENCIES, GP-13

North Dakota

North Dakota Agricultural Exp. Stn.
Fargo, ND

USDA Agricultural Research Service
Northern Great Plains Research Center

South Dakota

South Dakota Agricultural Exp. Stn.
South Dakota State University
Brookings, SD

Nebraska

Nebraska Agricultural Exp. Stn.
University of Nebraska

Nebraska Dept. of Forestry,
Fisheries & Wildlife

USDA Soil Conservation Service
Midwest National Tech. Service Ctr.
Lincoln, NE

USDA Forest Service
Rocky Mtn. Forest and Range Exp. Stn.
Lincoln, NE

Kansas

USDA Agricultural Research Service
Wind Erosion Laboratory
Manhattan, KS

Kansas State and Extension Forestry
Manhattan, KS

Oklahoma

Oklahoma Agricultural Exp. Stn.
Oklahoma State University
Stillwater, OK

Texas

Texas Agricultural Experiment Stn.
Texas A & M University
College Station, TX

Texas Forest Service
Texas A & M University
College Station, TX

Extension Forester
Texas Agricultural Extension Serv.
USDA, Texas A&M University System
College Station, TX 77843

New Mexico

New Mexico Agricultural Exp. Stn.
New Mexico State University
Las Cruces, NM

USDA Forest Service
Southwestern Region
Albuquerque, NM

Colorado

Colorado Agricultural Exp. Stn.
Colorado State University
Fort Collins, CO

Colorado State Forest Service
Colorado State University
Fort Collins, CO

USDA Forest Service
Rocky Mountain Region
Lakewood, CO

USDA Forest Service
Rocky Mtn. Forest & Range Exp. Stn.
Fort Collins, CO

Wyoming

Wyoming Agricultural Experiment Stn.
University of Wyoming
Laramie, WY

Wyoming State Forestry Division
1100 West 22nd St.
Cheyenne, WY 82002

Montana

Montana Agricultural Experiment Stn.
Montana State University
Bozeman, MT

Montana Department of State Lands
Missoula, MT

USDA Forest Service
Northern Region
Missoula, MT

Saskatchewan

PFRA Tree Nursery
Indian Head, Saskatchewan
SOG 2KO Canada

It is planned that individuals at these locations will maintain and keep the master sets up to date. If the location of the master sets are moved, the new location should be noted in the current year's proceedings. Consideration should be given to noting the location of all the master sets in each year's proceedings.

I would like for someone from New Mexico to receive the complete set of proceedings that I have in storage within the next two to three months.

Report of Awards Committee
Forestry Committee - G.P.A.C.

Chairman Richard Gavit reported the committee had selected two recipients for the Award of Merit from the Forestry Committee. The awards will be presented during the banquet on July 12, 1983.

Awards of Merit presented as follows for 1983:

Recipient - Certificate Notation - Nominator

Robert H. Heintz, North Dakota

Numerous contributions to windbreak and shelterbelt forestry in the Northern Great Plains. An active member of the Forestry Committee-G.P.A.C. for several years, including serving as past chairman.

- Albert B. Frank

Glenn W. Peterson, Nebraska

Leadership in tree disease research for nurseries throughout the Great Plains, for leadership of conifer disease research in the Great Plains, and many years of service to the Forestry Committee.

- Walter T. Bagley

Awards Committee

Richard Gavit
Norm Smola
Keith Tichnor
Albert Frank

HISTORICAL SUBCOMMITTEE REPORT
By
David L. Hintz, Member

A complete master set of all the proceedings of the Forestry Committee of the Great Plains Agricultural Council have been established for all ten Great Plains states and Saskatchewan. Master sets are on file or have been sent to the following locations:

Colorado
Rocky Mtn. Forest & Range Experiment Station
USDA Forest Service
240 West Prospect
Fort Collins, CO 80523

Kansas
Extension Forester
Environmental Forestry
Cooperative Extension Service
2610 Claflin Road
Manhattan, KS 66504

Montana
Department of State Lands
Division of Forestry
2705 Spurgin Road
Missoula, MT 59801

Nebraska
(Complete set is presently in storage--contact David L. Hintz, USDA, Soil Conservation Service, MNTC, Federal Building, Room 345, 100 Centennial Mall North, Box 82502, Lincoln, Nebraska 68501, if a permanent site to store the proceedings can be found somewhere in New Mexico.)

North Dakota
Agricultural Research Service
Northern Great Plains Research Center
P. O. Box 459
Mandan, ND 58554

Oklahoma
State Staff Forester
Soil Conservation Service
USDA Agricultural Center Building
Farm Road & Brumley Street
Stillwater, OK 74074

South Dakota
Extension Forester
Horticulture and Forestry Dept.
Ag Hall
South Dakota State University

Texas
Extension Forester
Texas Agricultural Extension Service
USDA, Texas A&M University System
College Station, TX 77843

Wyoming
Wyoming State Forestry Division
1100 West 22nd St.
Cheyenne, WY 82002

Saskatchewan
PFRA Tree Nursery
Indian Head, Saskatchewan
SOG 2KO Canada

It is planned that individuals at these locations will maintain and keep the master sets up to date. If the location of the master sets are moved, the new location should be noted in the current year's proceedings. Consideration should be given to noting the location of all the master sets in each year's proceedings.

I would like for someone from New Mexico to receive the complete set of proceedings that I have in storage within the next two to three months.

PLANTING TRENDS IN THE GREAT PLAINS

Richard M. Jeffers

Distribution of conifer, broadleaf, and shrub planting stock in the Great Plains in 1970, 1975, and 1980 is summarized in Table 1. These tables are summaries of data included in the Proceedings of the Annual Meetings of the Forestry Committee, GPAC Tree Planting Trends. It is interesting to note that there was a significant increase in distribution in planting stock of over 4.4 million plants between 1970 and 1975 and only a slight decrease (233 thousand) between 1975 and 1980. Since 1970 there has been a steady increase from 4.2 million in 1970 to 6.2 million in 1980, in conifer stock distribution; a significant increase in broadleaf distribution from 2.7 million in 1970 to 4.0 million in 1975 and a slight decrease to 3.9 million in 1980; while shrubs increased significantly from 1970 to 1975 (2.0 to 3.4 million) followed by a substantial drop of nearly 500 thousand shrubs between 1975 and 1980. While these general trends have occurred, the relative percentages of conifers, broadleafs, and shrubs have stayed essentially the same during this period with conifers making up slightly less than half of all the stock, broadleafs about 30 percent, and shrubs slightly more than 20 percent.

Conifers

Conifer distribution for 1970, 1975, and 1980 is summarized in Table 2. Between 1970 and 1980 there were steady increases in distribution of eastern red cedar, blue spruce, and Austrian pine. Scots pine during this period increased by over 50 percent from 1970 to 1975, then stayed about the same until 1980. In comparison, Rocky Mountain juniper and ponderosa pine increased significantly between 1970 and 1975, but decreased significantly between 1975 and 1980. These decreases have probably resulted from the unreliability of consistent seed and seedling production in Rocky Mountain juniper and inconsistency of long term survival of ponderosa pine seedlings. Because of the desirability of both of these species for use in Great Plains plantings, improving technology of seed production and seedling establishment will probably result in an increase in their use in future planting programs.

Broadleafs

Distribution of broadleaf species in 1970, 1975, and 1980 is summarized in Table 3. There was a significant increase in broadleaf distribution from 2.7 million in 1970 to 4.0 million in 1975 and a slight decrease to 3.9 million in 1980. Of particular note is the steady increase in the use of green ash (376 to 969 thousand), hybrid poplars (10 to 244 thousand), and black locust (39 to 235 thousand) from 1970 to 1980. And as one might expect, there has been a steady decrease in the use of elms, especially American and Siberian elms, during this same period. Other species such as Russian olive, osage-orange, mulberry, cottonwood, and golden willow increased between 1970 and 1975, but decreased in use from 1975 to 1980. Perhaps the more important reason for the decrease in use of these species has been increased incidence of pest problems and lack of genetic variability and/or genetic information on these species. As more genetic information and variation, especially increased resistance, become available, these species will probably be in greater demand for planting in the Plains.

Shrubs

Shrub distribution in 1970, 1975, and 1980 is summarized in Table 4. In contrast to the trends in use of conifers and broadleafs, use of shrubs increased significantly from 2.0 to 3.4 million plants between 1970 and 1975, followed by a substantial decrease to 2.9 million in 1980. Between 1970 and 1980 there was a steady increase in the use of cotoneaster, autumn olive, honeysuckle, fragrant sumac, and common lilac. In comparison, there does not appear to be any species of shrubs that have consistently decreased in use. Several shrub species, however, did increase in use between 1970 and 1975 to be followed by a decrease in their use; included in this group are Siberian peashrub, Siberian crab, Nanking cherry, American plum, and multi-flora rose.

Perhaps it is to be expected to see these patterns in the use of shrubs because there has been an increasing interest in the use of this group of plants in the Plains for shelterbelts, wildlife, and other multiple use purposes since 1970. Consequently, between 1970 and 1980 many shrub plantings with various species were established for several uses, and because of this relatively rapid growth and the short lives of shrubs, many species have since been found to be undesirable for one or more uses. In the future we will probably see less shrub species trials established and steady increases in use of species that have considerable merit for multiple uses.

Table 1 - Tree and Shrub Distribution in the Great Plains

	1970		1975		1980[2/]	
	M	%	M	%	M	%
Conifers[1/]	4,166	47	5,856	44	6,230	48
Broadleafs	2,743	31	4,016	30	3,904	30
Shrubs	1,970	22	3,416	26	2,921	22
Totals	8,879		13,288		13,055	

1/ Southern pines not included

2/ Texas data not included

Table 2 - Conifer Distribution in the Great Plains

(M trees)

Species	1970	1975	1980[2/]
Abies-White Fir	14	23	11
Cupressus-Arizona		1	2
Juniperus-Eastern Redcedar	1,798	1,619	2,423
Rocky Mt. Juniper	130	449	209
One-seed	6		
Larix-Western		30	
Siberian		15	5
Picea-Blue	417	675	923
Engelmann		51	18
White	92	22	112
Pinus-Afghanistan			6
Austrian	254	497	257
Eastern White	66	34	38
Jack	3	1	45
Lodgepole		35	19
Pinyon	5	4	1
Ponderosa	831	1,404	770
Scots	513	777	762
Taxodium-Bald Cypress		5	
Thuja-Oriental Arborvitae	19	113	84
Pseudotsuga-Douglas-fir	18	101	45
Total	4,166	5,856	6,230

1/ Southern pines not included

2/ Texas figures data not included

Table 4 - Shrub Distribution in the Great Plains

(M Shrubs)

Species	1970	1975	1980
Alnus-European Black	3		
Amelanchier-Juneberry	2	14	1
Artemesia-Sage	6		
Caragana-Siberian Peashrub	624	958	643
Cephalanthus-Bottonbush	7		
Cornus-Red Osier	1	42	40
Cotoneaster	113	118	169
Crataegus-Hawthorne		1	
Elaeagnus-Autumn Olive	5	56	111
Silverberry		1	
Euonymus-Winterberry	7	23	13
Eurotia-Winterfat		43	12
Lonicera-Honeysuckle	321	482	580
Malus-Hardy	1		
Manchurian Crab		1	43
Siberian Crab	26	103	64
Prunus-Russian Almond		1	
Chokecherry	92	80	85
Nanking Cherry	65	277	129
Sand Cherry	53	164	38
American Plum	250	405	313
Rhus-Fragrant	34	33	120
Ribes-Golden Currant		16	14
Robinia-Bristly Locust		4	
Rosa-Hansen	13	27	26
Multiflora	99	105	39
Salix-Diamond			2
Laurel		4	
Purple	3	4	
Shepherdia-Buffaloberry	42	135	138
Symphoricarpus-Snowberry			15
Syringa-Common	198	267	326
Late		52	
Tamarix	5		
Total	1,970	3,416	2,921

Table 3 - Broadleaf Distribution in the Great Plains

(M Trees)

Species	1970	1975	1980[1/]
Acer-Amur	21	22	26
Boxelder	4		
Silver	41	67	74
Carya-Pecan	38	51	69
Catalpa	8	13	24
Celtis-Hackberry	52	89	136
Cercis-Redbud	24	29	23
Elaeagnus-Russian Olive	422	951	778
Eucalyptus	7	3	
Fraxinus-Green	376	708	969
Gleditsia-HoneyLocust	110	75	166
Juglans-English		19	
Black	164	287	282
Liquidambar-Sweetgum	7	3	
Maclura-Osage Orange	13	128	38
Morus-Mulberry	37	97	57
Platanus-Sycamore	19	21	15
Populus-Cottonwood (includes Siouxland)	170	224	162
Lombardy	17	14	4
Narrowleaf	1	4	9
Plains			5
Hybrids	10	117	244
Prunus-Apricot	9	7	21
Chickasaw Plum		9	
Pyrus-Harbin Pear	10	3	2
Quercus-Bur	13	12	25
Cherrybark			
Red		19	
Robinia-Black Locust	39	79	235
Salix-Diamond	4	2	
Golden	67	134	97
White	24	43	19
Ulmus-American	81	49	4
Chinese	14	1	35
Chinkota	120		
Dropmore	171	175	
Siberian	650	561	334
Total	2,743	4,016	3,904

1/ Texas data not included

TREE AND SHRUB IMPROVEMENT NEEDS IN THE GREAT PLAINS

Richard M. Jeffers

At the 1982 annual meeting of the GP-13 Committee "Improved Tree and Shrubs for Planting on the Great Plains" in Dodge City, Kansas, it was agreed upon that a survey would be made to determine tree and shrub improvement needs for the Great Plains. This evaluation was made to update the initial survey of tree improvement work on the Great Plains which was summarized by Naughton (1973). Bibliographies on tree and shrub improvement research relative to the Great Plains have been prepared for the GP-13 Committee by Woessner (1973) and Cunningham (1982). Consequently, a review and summary of literature pertinent to this subject area will not be included in this report.

In 1981 Cunningham published a summary of tree improvement activities involving windbreak species. Because Cunningham's paper includes essentially all of the tree and shrub improvement research projects underway in the Great Plains, a summary of these projects is not included in this needs projects summary. However, to determine what tree and shrub improvement needs still remain in the Great Plains, a questionnaire was sent in late 1982 to 26 agencies requesting information on tree and shrub improvement needs. Each agency was to prioritize up to three tree and shrub species and traits to be improved in need of genetic improvement for use on the Great Plains. A total of 17 responses from one or more combined agencies was received.

A summary of agency responses by species and traits in need of improvement is included in Table 1. A list of responding agencies and assigned agency numbers is included in Table 2.

Species priorities for each agency were rated:

Species Priority	Weight
1	3
2	2
3	1

Total weights for each species were determined. Species needs are listed in Table 1 from the highest total weight to the lowest weight. For nearly all species, traits to be improved include survival, broad adaptability, growth, form, and resistance to pests and drought. Three species--bur oak, green ash, and Russian olive, were listed by six or more agencies and their total weighted scores exceeded ten. These species and perhaps the number four ranked species, Siberian elm, are all possible candidates for the GP-13 Committee to consider, in addition to the continuing Juniperus and hackberry programs, as future tree improvement activities.

Table 1 - Tree and Shrub Improvement Needs in the Great Plains

Species	Total Needs Weight 1/	Agencies	Traits to Improve
Quercus macrocarpa, Bur Oak	23	1,2,3,4,5,14,15,16,17	Survival, growth, form
Fraxinus pennsylvanica, Green Ash	18	1,5,8,12,14,15,16	Survival, growth, resistance (borer,drought frost)
Elaeagnus angustifolia, Russian Olive	14	1,2,3,4,6,7	Thornless, resistance (disease,winter injury)
Ulmus pumila, Siberian Elm	8	2,6,7,8	Resistance (chemical, disease), longevity
Gleditsia triacanthos, Honey Locust	4	3,15	Resistance (cold, disease)
Pinus nigra, Austrian Pine	4	6,17	Growth, resistance (cold)
Pinus ponderosa, Ponderosa Pine	4	9,14	Survival, growth, form, resistance(insects)
Populus sp, Cottonwood and Hybrids	4	4,9	Resistance (disease, drought)
Abies concolor, White Fir	3	12	Growth, form
Acer negundo, White Fir	3	11	Survival, form
Maceura pomifera, Osage Orange	3	13	Seedless, thornless
Amelanchier alnifolia, Saskatoon Serviceberry	2	11	Desirable traits
Juglans nigra, Black Walnut	2	5	Survival, growth, form
Prunus virginiana, Chokecherry	2	7	Survival, resistance (disease)
Caragana arborescens, Caragana	1	8	Variability
Crataegus sp, Hawthorne	1	13	Broad adaptation
Juniperus communis, Common Juniper	1	9	Windbreak suitability (3-5 feet)
Pinus sylvestris, Scots Pine	1	16	Christmas trees
Platanus occidentalis, Sycamore	1	10	Growth, form, resistance, (disease,drought)
Prunus americana mexicana, Mexican Phum	1	11	Fruit, reduction, suckering reduction

1/ Species weights: 1st priority-3, 2nd priority-2, 3rd priority-1

Table 2 - Agencies Responding to Tree and Tree and Shrub Improvement Needs Request

1. Montana Department of State Lands
   2705 Spurgin Road
   Missoula, MT 59801

2. Montana Interagency Tree & Shrub Improvement Study (MITOSIS)
   c/o Mr. Harold Hunter
   USDA Soil Conservation Service
   P. O. Box 9780
   Bozeman, MT 59715

3. Plant Materials Center
   USDA Soil Conservation Service
   Federal Building, Box 1458
   Bismarck, ND 58501

4. Northern Great Plains Res. Ctr.
   USDA Agricultural Research Center
   P. O. Box 459
   Mandan, ND 58554

5. North Dakota Forest Service
   NDSU-Bottineau Branch
   Bottineau, ND 58318

6. Horticulture & Forestry Dept.
   South Dakota State University
   Brookings, SD 57006

7. South Dakota Division of Forestry
   Department of Game, Fish & Parks
   Sigurd Anderson Building
   Pierre, SD 57501

8. USDA Forest Service
   Rocky Mtn. Forest & Range Experiment Station
   Forestry Research Laboratory
   South Dakota School of Mines and Technology
   Rapid City, SD 57701

9. Wyoming State Forestry Division
   1100 West 22nd Street
   Cheyenne, WY 82002

10. Nebraska State Forest Service
    Room 101, Plant Industry Bldg.
    Univ. of Nebraska, East Campus
    Lincoln, NE 68503

11. Department of Forestry
    107 Plant Industry Building
    Univ. of Nebraska, East Campus
    Lincoln, NE 68583

12. USDA Forest Service
    Rocky Mtn. Forest and Range Experiment Station
    Forestry Sciences Laboratory
    Univ. of Nebraska, East Campus
    Lincoln, NE 68583

13. USDA Soil Conservation Service
    P. O. Box 600
    Salina, KS 67401

14. Department of Forestry
    Call Hall
    Kansas State University
    Manhattan, KS 66506

15. Kansas State & Extension Forestry
    2610 Claflin Rd.
    Manhattan, KS 66502

16. Department of Forestry
    Oklahoma State University
    Stillwater, OK 74074

17. Texas Forest Service
    Rt. 3, Box 216
    Lubbock, TX 79401

References

Cunningham, Richard A. 1981. Tree improvement activities involving windbreak species. In: Proc. Second North Central Tree Improv. Conf. Lincoln, NE, August 5-7, 1981, p. 48-64.

Cunningham, Richard A. 1982. Bibliography of tree and shrub improvement research relevant to the Great Plains. Report prepared for the GP-13 Committee.

Naughton, Gary G. 1973. The status of tree improvement work on the Great Plains. Report prepared for the GP-13 Committee.

Woessner, Ronald A. 1973. Bibliography of tree and shrub research relevant to the Great Plains. Report prepared for the GP-13 Committee.

GP-13 Technical Committee Meeting
Billings, Montana, July 11, 1983

GP-13 Technical Committee Cooperative Provenance Test of hackberry, Celtis occidentalis.

Dr. Richard A. Cunningham, Study Coordinator, USDA-ARS, Mandan, ND.

Objectives of the study:

1. Identify the extent and patterns of genetic variability within hackberry growing in ND, SD, MN, NE, IA, MO, KS, OK, AR and Manitoba, Canada.

2. To identify the seed sources of hackberry best adapted for planting in ND, SD, MN, NE, IA, MO, KS, OK, and AR.

3. To provide a highly variable gene pool that could be utilized for future selections and breeding.

Current Status: Projected total number of collections - 275. A total of 58 field collections have been processed at the USDA-SCS, PMC, Bismarck, ND. Clean seed amounts range from 39 to 3,439 grams.

North Dakota - 14

County	
Cass	(2)
Trail	(1)
Barnes	(1)
Benson	(2)
Ransom	(1)
Richland	(1)
Ramsey	(2)
McHenry	(1)
Kidder	(1)
Morton	(1)

South Dakota - 8

County	
Day	(1)
Brookings	(1)
Hand	(1)
Spink	(1)
Coddington	(1)
Beadle	(1)
Potter	(1)
Stanley	(1)

Minnesota - 9

County	
Bigstone	(1)
Houston	(2)
Lac Qui Parle	(1)
Swift	(2)
Lincoln	(1)
Clay	(1)
Polk	(1)

Kansas - 12

County	
Crawford	(1)
Pratt	(1)
Boyd	(1)
Butler	(2)
Ellis	(1)
Pawnee	(1)
Comanche	(1)
Clark	(1)
Sedgewick	(1)
Jewell	(1)
Barber	(1)

Nebraska - 11

County	
Thayer	(1)
Nance	(1)
Adams	(1)
Dawson	(1)
Boone	(1)
Sherman	(1)
Clay	(1)
Hall	(1)
Custer	(1)
Cherry	(2)

Oklahoma - 3

County	
Grant	(3)

Canada - 1

Manitoba	(1)

( ) Number of collections

MINUTES

Meeting of the Pest Management Task Force
of the Great Plains Forestry Committee
Billings, Montana, July 11-14, 1983

The Pest Management Task Force met jointly with the Forestry Committee starting at 1:30 p.m., Monday, July 11, 1983 in Billings, Montana. Glenn Peterson (USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Lincoln, NE) reported to the group about the status of the Great Plains Tree Disease Handbook. Approximately 31 of 65 chapters have been turned over to the editor for final editing. Questions were raised as to why only include tree diseases. Glenn replied that there was also an Insect Handbook being prepared by several authors headed by Mary Ellen Dix. He also announced that a bibliography of Forest Pests, listing research papers prior to 1982, will soon be available from his office. Peterson requested that the Forestry Committee form a special committee to seek funding for the handbook, which is estimated to cost $27,000. This joint meeting was adjourned at 3:00 p.m., after which both committees met separately.

The Task Force reconvened at 3:30 p.m. for state reports. The following are highlights from each presentation:

1. Dr. William Jacobi - Colorado State University Research at C.S.U. includes: In Vitro experimentation with Thyronectria canker of honey-locust; urban pest survey methodology to evaluate methods of surveying for incidence and severity of diseases; ponderosa pine-dwarf mistletoe-relationships with site factors; comandra rust incidences and growth loss; comandra rust risk rating and ponderosa pine dwarf-mistletoe-impact in uneven-aged stands.

2. Richard Dorset - Division of Forestry, South Dakota. One gypsy moth was found in the Black Hills and was traced to a camper vehicle. An aerial spray of Bacillus thuringiensis was applied near Aberdeen, SD to control spring canker worms. Sixty-five communities have been surveyed for Dutch elm disease and over 4,000 trees have been marked and removed. A survey for mountain pine beetle in the Black Hills indicates populations are declining. A shelterbelt survey for insects and diseases was completed and will be analyzed later.

3. Dr. Joe Krupinsky - USDA, Mandan, ND. Research includes surveying for canker and die back diseases of Siberian elm and screening for resistance. Screening lines of poplar for resistance to canker and leaf spot diseases, especially Septoria musiva. Isolations from stem canker of Russian olive indicate that Tubercularia ulmea, Phomopsis elaeagni and Botryodiplodia theobromae may be cause agents. Pathogenicity of these isolates will be studied.

4. Dr. Glenn Peterson, USDA Forest Service, Lincoln, NE. Glenn reported on all projects active with the research group at Lincoln which included: GP-13 Juniperus seed source study, jack pine flowering study, progeny test of scotch pine seed orchard selections, limber pine and

southwestern white pine evaluated at age seventeen, progeny test of eastern redcedar, transfer of tree improvement studies from Bottineau, resistance of Siberian elm to canker worms, detection and evaluation of Prionoxystus robiniae (carpenterworms on hardwoods), assessment and control of pitch twig moths (Petrova metallica) on pines, biology and control of the western pinetip moth (Rhyacionia bushnelli), identification, biology and control of insects damaging the seeds and cones of ponderosa pine, identification, biology and control of ash seed weevils, Fomes fraxin-ophilus stem decay of green ash; incidence and damage, Phellinus robineae stem decay of black locust; infection and damage, endemic ectomycorrhizae fungi of Pinus ponderosa in central Great Plains plantings; identification of fungi and synthesis of ectomycorrhizae, diseases of honeylocust; etiology and biology, resistance of Juniperus virginiana to Phomopsis juniperovora, resistance of Juniperus virginiana and J. scopulorum to Cercospora sequoiae var. juniperi, Diplodia pinea blight of pines, and resistance to Dothistroma pini in Austrian pine progenies.

5. Jim Walla - North Dakota State University. The research group at NDSU is currently working on: shelterbelt disease survey, etiology of ash anthracnose, taxonomy and host range of Melampsora rust on Populus, Lophodemium needle cast of pine, western gall rust of pine, green ash heartrot-resurvey, Phellinus punctatus canker rot of trees and shrubs, Dutch elm disease in shelterbelts, Siberian elm cankers and canker worm interactions, and blackstem on poplars.

6. Dr. Kenneth Conway - Oklahoma State University. The disease survey of windbreaks in two counties in Oklahoma was completed and published in Plant Diseases 67:289-291. Results indicate that incidence and severity of diseases in the Southern Plains are different from those reported in the Northern Plains. Research has been initiated to determine the feasibility of using biological control strategies for soilborne diseases in tree nurseries in cooperation with the Oklahoma Division of Forestry.

7. Steve Kohler - Montana State Forest Service, Missoula, Montana. Steve summarized Forest Insect and Disease Conditions 1982 in Montana, which is available as Report 83-2. The mountain pine beetle continues to be the most destructive forest insect. Spruce beetle and Douglas-fir beetle infestations are increasing.

8. Bruce Neill - PFRA Tree Nursery, Indianhead, Saskatchewan. The tree nursery distributes trees for shelterbelt plantings across the Canadian Prairies. Entomological research projects include: determination of sex attractant and practical control methods for cottonwood crown borer (Sesia fibialis), determination of sex attractants of the spring canker worm (Paleacrita vernata), inventory of buffaloberry fruit pests, pheromones for monitoring shelterbelt pests, life history and control of the willow redgall sawfly (Pontania proxima), screening poplar selections for resistance to the poplar bud gall mite (Aceria parapopuli), and Dutch elm disease and elm bark beetle surveillance.

9. Scott Tunnock - USDA, Forest Service, Missoula, Montana. A biological evaluation of the variable oakleaf caterpillar (Heterocampa manteo) was conducted in 1982 and 1983. Populations in 1983 were low and no spray was needed. A cooperative study of carpenterworm pheromone traps was initiated in 1982 with Mary Ellen Dix, USDA Forest Service, Lincoln, NE.

10. Dr. Robert James - USDA Forest Service, Missoula, Montana. Research projects include nursery diseases, pinetip dieback, and evaluation of Sirococcus strobilinus. Red band needle blight is becoming more important in the Mountain Region.

11. Robert Averill - USDA Forest Service, Lakewood, Colorado. Pest management in Region 2 is not very active in the Plains. Projects include mountain pine beetle surveys and gypsy moth trapping in Colorado. The Douglas-fir tussock moth has become a pest of urban areas in Colorado. Questions were raised concerning why an integrated pest management system could not be developed in the Great Plains to disseminate information concerning insects and disease.

12. Mark Harrell - Nebraska Forest Service. Projects concern the biology and control of the Zimmerman pine moth (Dioryctria zimmermani) and the evaluation and development of treatments for chlorosis of pin oak and silver maple.

A report of research activities of USDA Forest Service Southern Region, Pineville, Louisiana, was also read.

The meeting was temporarily adjourned at 5:15 p.m. and reconvened at 7:00 p.m.

Business Meeting

Nominations for Co-Chairman (Entomologist) and Secretary-Treasurer were taken and Scott Tunnock and Kenneth E. Conway were elected Co-Chairman and Secretary-Treasurer, respectively.

A motion by Walla to meet separately from the Forestry Committee next year was passed. A motion by Averill to meet in Denver, Colorado was passed after discussion about Lincoln, Nebraska and travel for Forest Service personnel. The meeting will be hosted by Region 2 - Robert Averill.

A motion by Jacobi to hold the meeting during either the last two weeks of March or first two weeks of April was passed. The exact date will be determined by the Executive Committee and the local arrangement committee.

Motion for adjournment by Walla was passed at approximately 9:45 p.m. Monday, July 11, 1983.

Kenneth E. Conway
Secretary/Treasurer

If you would like to continue receiving minutes and announcements from the Forest Pest Management Task Force, please send your name and address to:

Dr. Kenneth E. Conway
Department of Plant Pathology
Oklahoma State University
Stillwater, OK 74078

NOTICE!

Limited copies of "Forest Insect and Disease Publications of the Great Plains," compiled by Dix, Pasek, and Peterson (1983) will be available this summer from the USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colorado 80526. The bibliography, which lists 335 forest insect and 323 forest disease research and extension citations published before February 1982, was compiled for the Pest Management Task Force of the GPAC Forestry Committee. Keyword and author indices are included.

Chairman's Comments - Business Meeting
July 11, 1983 Billings, Montana

Mailing Lists - Proposed procedure

1. Immediate past host forwards their mailing lists to the Secretary-Treasurer. Secretary-Treasurer gives copy to new host.

2. New host distributes copies to state representatives requesting an update (corrections, additions, deletions).

3. New host collects results and prepares an updated listing to be used for the next meeting. Furnish a copy to the Secretary-Treasurer.

4. Secretary-Treasurer repeats cycle by forwarding the listing to the next host.

An alternative is to centralize the operation in one area with a computer, and computer updating capability. The Secretary-Treasurer would remain responsible for the over-all operation. Any volunteers?

Response to Tree Improvement Research Resolutions

Last meeting we passed three resolutions expressing our concern about recent cutbacks on the part of Federal and State agencies and land grant institutions in Great Plains tree improvement research. These resolutions were forwarded to all Experiment Station Directors, Deans of Agricultural Colleges, Directors of Forest and Range Experiment Stations, and other member agencies.

Some responses were received. Most supported the need for continuing tree improvement research in the Great Plains area, but details on what actions might be taken were vague.

Responses were received from: CSRS - WO
SCS - KS
FMHA - NM
OSU - Department of Forestry
USFS - R-2 and R-3

National Arbor Day Foundation Grant

Last December the National Arbor Day Foundation (John Rosenow) contacted Chairman Ripley requesting a financial donation to help in the distribution of public service announcements promoting windbreaks in the Great Plains area. After consultation with members of the Executive Committee and our Administrative Advisor, it was agreed to grant the Foundation $300. This was done in June. The Foundation has acknowledged receipt with thanks. Distribution of the public service announcements has started.

Tree Planting Trends - For Clark

There will be no report this year. Next year's report will cover the 2 year period. Should these reports continue to be done annually or would another time frame suffice?

Closing Remarks

About a year ago Administrative Advisor John Vetterling received a letter from a past Forestry Committee member that was critical of the way our annual meetings have grown in attendance. John asked several of us for advice on how to reply.

In responding to John's request, I was forced to closely examine my thoughts on the value of the GPAC-Forestry Committee, and I'd like to share these with you.

- The Forestry Committee serves a vital function in providing a medium for plains foresters to periodically assemble to exchange new ideas, identify problems and seek solutions, maintain interpersonal contacts between educators, researchers, field and extension foresters, and more importantly, the mix among such people. Moreover, the Forestry Committee is the only Great Plains organization to provide this opportunity.

- Meeting attendance and committee participation are voluntary. People will attend, and our employing agencies will continue to pay our way only if there are benefits in doing so. Our annual meetings, workshops, et. al must continue to offer something of high value to sustain this interest. We've been successful for about 35 years. Let's continue this success in the years ahead.

REPORT TO THE FORESTRY COMMITTEE (RESEARCH FORUM)

OF THE GREAT PLAINS AGRICULTURAL COUNCIL

Billings, Montana, July 1983

STATION: USDA, FOREST SERVICE
ROCKY MTN. FOREST & RANGE EXPERIMENT STATION
FORESTRY SCIENCES LAB.
UNIVERSITY OF NEBRASKA
LINCOLN, NEBRASKA 68583

PROJECT: PROTECTION AND IMPROVEMENT OF TREES IN THE GREAT PLAINS

MISSION: TO PROVIDE TECHNOLOGY FOR REDUCING DETRIMENTAL EFFECTS OF DISEASES AND INSECTS, TO SELECT ADAPTED TREE SPECIES, AND TO DEVELOP GENETICALLY IMPROVED SEED FOR PLAINS PLANTINGS

AREA OF RESEARCH ADAPTABILITY: THE GREAT PLAINS

PERSONNEL: Glenn W. Peterson, Project Leader, Plant Pathologist
Jerry W. Riffle, Plant Pathologist
David F. Van Haverbeke, Research Forester
Mary Ellen Dix, Research Entomologist
Judith Pasek, Research Entomologist

PROGRESS OF CURRENT STUDIES

GP-13 Juniperus Seed Source Study

The 204-source eastern redcedar (J. juniperus L.) and Rocky Mountain juniper (J. scopulorum Sarg.) field test established in the spring of 1981 at Hastings in Southcentral Nebraska (part of the Plains-wide GP-13 cooperative study) was measured for third-year field survival and performance. Overall survival was 97.4%, and overall height was 115.5 cm (46.4 in). (D. F. Van Haverbeke).

Jack Pine (P. banksiana Lamb) Flowering Study

Conelets were counted on a 500 seedling cooperative (NC-99) genotype x environment interaction test of flowering and seed production established in 1979 at Hastings in Southcentral Nebraska. Ten families from each of five provenances from Wisconsin, Minnesota, Michigan, and Ontario, Canada are represented in this test, one of six identical plantations established along a latitude, temperature, and precipitation gradient throughout the northcentral region. The objective of the study is to develop guidelines for the selection of jack pine seed orchard sites.

Summary of ovulate and staminate conelet production is as follows:

Year	No. trees	♀ Conelets: Total No.	♀ Conelets: Average no. per tree	♀ Conelets: Range per tree	♂ Conelets: Total No.	♂ Conelets: Average No. per tree	♂ Conelets: Range per tree
1980	500	264	0.53	0-11	0	0	0
1981	500	730	1.46	0-18	0	0	0
1982	500	9818	19.64	0-143	1629	3.26	0-75
1983	497	83278	167.56	0-362	18634	37.49	0-135

(D. F. Van Haverbeke)

Progeny Test of Scotch Pine (P. sylvestris L.) Seed Orchard Selections

Container grown, 2+0, control-pollinated Scotch pine seedlings were field planted in progeny tests in the spring of 1981 in eastern Nebraska at Mead (3890 seedlings), and in south central Nebraska at Grant Island (800 seedlings), and Hastings (3,360 seedlings). The field designs included 4-tree linear plots (Hastings) and single-tree plots (Grand Island and Mead). These progeny tests were designed and initiated to test the genetic worth of earlier selected phenotypes whose vegetatively propagated ramets comprise a 10-acre, 1,000 tree clonal seed orchard at the University of Nebraska Mead Field Laboratory. The first seedlings originating from seed collected from this first-generation seed orchard will be distributed through the Clarke-McNary Tree Distribution Program in the spring of 1983. (D. F. Van Haverbeke).

Limber Pine (P. flexilis) and Southwestern White Pine (P. strobiformis) Evaluated at Age Seventeen

First- and 17-year survival percentages were 32 and 15 for Pinus flexilis and 85 and 72 for P. Strobiformis. Fourteen of 32 P. Flexilis and 1 of 17 P. strobiformis progenies died during that period. Differences in survival were significant between species and among progenies within species. Surviving P. flexilis trees attained a mean height of 7.1 m (23.3 ft). Differences in heights were significant between species but not among progenices within species. P. flexilis, except for low elevations, easternmost sources, is of little value for Great Plains plantings because of low survival and slow growth. P. strobiformis shows good potential for the Great Plains if seed is collected from higher elevations in central Arizona and New Mexico. (D. F. Van Haverbeke).

Progeny Test of Eastern Redcedar (Juniperus virginiana L.)

An open-pollinated progeny test of 27 eastern redcedar trees, selected for narrowness of crown, was established in the spring of 1983 at the University of Nebraska Field Laboratory near Mead, Nebraska. Seedlings (2+0, container-grown) were machine-planted in the form of a 3-row windbreak in a randomized complete block design with 4-tree linear plots, replicated 10 times. These progenies will be evaluated to determine the genetic worth of the 27 ovulate selections of the species, which were established in 1982-3 in a clonal seed orchard at the Field Laboratory. (D. F. Van Haverbeke).

Transfer of Tree Improvement Studies from Bottineau

Tree improvement studies, previously conducted by the Bottineau Unit, have been transferred to the Lincoln Unit of the Rocky Mountain Forest and Range Experiment Station, Lincoln, Nebraska. These include six (6) studies, involving the following tree species: ponderosa pine, Scotch pine, Rocky Mountain juniper, eastern redcedar, blue spruce and green ash.

Resistance of Siberian elm to cankerworms; impact of cankerworms on Siberian elm

Spring cankerworms (Paleacrita vernata) severely defoliate Siberian elms in both urban and rural plantings in the northern Great Plains. Siberian elms which are resistant or tolerant to cankerworm defoliation have been identified in shelterbelts by Dr. R. Cunningham, USDA-ARS, Mandan, ND., and USDA-Forest Service personnel. During 1982 and 1983, the feeding behavior of cankerworms on leaves from Siberian elm selected for tolerance or resistance to cankerworm defoliation was compared to those from trees selected for other morphological characteristics and to non-select trees from the same plantings. The leaves tested in these trials were collected from rooted cuttings propagated by Dr. R. Cunningham. The cankerworms were reared from eggs collected in Bottineau and Burleigh counties during the spring 1982 and 1983.

Since 1979 the effect of cankerworm defoliation on Siberian elm growth and food storage has been monitored by artificially defoliating Siberian elm and measuring the resulting growth. Dr. A. Frank, USDA-ARS, Mandan, ND is analyzing the trees for stored food. The field portion of this study has been completed. The greenhouse portion will be concluded in 1983. (M. E. Dix)

Detection and evaluation of Prionoxystus robiniae (Carpenterworms) on hardwoods

The larvae of carpenterworms construct tunnels in the wood of ash, elm, and poplar killing portions of or entire trees. A method of trapping male carpenterworms in forested areas by use of the pheromone (Z,E)-3,5-Tetradecadien-1-ol acetate was developed by USDA Forest Service personnel from the Great Plains and by Dr. J. Solomon, USDA Forest Service, Stoneville, Miss. We are now modifying this technique for use in shelterbelts. Trap placement in shelterbelts and effective distance of the pheromone were tested in 1981. Trap catches of male carpenterworms, infestation levels in shelterbelts and pheromone concentration were tested in 1982 and will be tested in 1984. The effectiveness of wick and septum pheromone dispensers will be compared in 1983. (M. E. Dix)

Assessment and Control of Pitch Twig Moths (Petrova metallica) on pines

Pitch twig moths infest pines, especially ponderosa, throughout the northern and central Great Plains. During 1982 and 1983, Ted Underhill, Canadian National Research Council, Saskatoon, Sask., performed electro-antennagrams on the male moths and identified several attractants of the males. During 1983 we will screen these attractants at various concentrations in the field. (M. E. Dix)

Biology and control of the western pine tip moth (Rhyacionia bushnelli) (New Study)

The western pine tip moth extensively damages the growing tips of young pine trees in the central and northern Great Plains. In 1983, we began documenting the life history of the tip moth in Nebraska. (J. E. Pasek)

Identification, biology and control of insects damaging the seeds and cones of Ponderosa Pine (New Study)

Each year insects such as cone worms (Dioryctria spp.) and seedbugs (Leptoglossus occidentalis) severely damage seeds in pine seed orchards. During 1983 the insects damaging the seeds and cones of ponderosa pine in Eastern Nebraska will be identified, their impact on the seed crop assessed, and the life history of the most important species documented. (J. E. Pasek)

Identification, biology, and control of ash seed weevils

Ash seed weevils (Lignoides spp.) can destroy up to 95% of the seed on a tree. During the summer and fall of 1980, the species of weevils infesting ash seed in North Dakota were identified and we began to document the biology of the weevils and their parasites. Because of a late freeze no seed was available in 1981 in North Dakota. In 1982, additional information was collected on the biology and impact of ash seed weevils in North Dakota and Nebraska. In 1983, we plan to obtain additional information on their biology. (M. E. Dix)

Fomes fraxinophilus stem decay of green ash: Incidence and Damage

The survey for F. fraxinophilus stem decay of Fraxinus pennsylvanica in Nebraska native stands initiated in 1979 was completed in 1981. Over 7,000 living green ash trees were examined in 361 plots in 10 multi-county forest inventory units. Based on occurrence of sporocarps, infected trees were found in 55% of the plots and in 86% of the counties. Incidence of infected trees ranged from 1.6% in southeastern Nebraska to 24% in northwestern Nebraska. We conclude that 10% of an estimated population of 20,014,810 living F. pennsylvanica in Nebraska woodlands are infected with F. fraxinophilus. This study was a cooperative effort by USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, by Region 2, Timber, Forest Pest, and Cooperative Forestry Management, and by the Nebraska Forest Service. A manuscript on the study will be submitted for publication in Plant Diseases in 1983. We are currently assessing damage (volume of decay) caused by F. fraxinophilus to green ash in Nebraska windbreaks. This assessment should be completed in 1983. (J. W. Riffle)

Phellinus robineae Stem Decay of Black Locust: Infection and Damage

A cooperative study of USDA Forest Service, Rocky Mountain Forest and Range Experiment Station and the Oklahoma Forestry Division was initiated in 1981 to investigate incidence, infection, and damage by Phellinus robineae to black locust in Oklahoma plantings. Incidence of Phellinus robineae infected trees was determined by examination of 14,957 black locust in 144 plantings of six ages in five major land resource areas (MLRA) from April 1981 to January 1982. Infected trees were found in 44% of the plantings. Incidence of infected trees between the five MLRA's

ranged from 0 to 7%. Incidence of infected trees in plantings of age 10, 15, 20, 24, 30, and 40 years was 0.1, 1.0, 3.6, 5.1, 10.0 and 25.8% respectively. From data obtained, we estimate that 14% of the living black locust age of 20, 24, 30, and 40 years in Oklahoma plantings are infected with P. robineae. Black locust trees are currently being dissected to determine infection counts for P. robineae and to assess damage caused by this pathogen. These dissections will be completed in 1983. (J. W. Riffle)

Endemic ectomycorrhizal fungi of Pinus ponderosa in central Great Plains plantings: identification of fungi and synthesis of ectomycorrhizae

Pure culture inocula of endemic ectomycorrhizal fungi for inoculation of pines used in Great Plains plantings have not been developed because the fungi have not been identified. A new study was initiated in 1982 under contract to Kansas State University (Forestry Department) to determine which ectomycorrhizal species occur in pine plantings in the Central Great Plains and which species are ectomycorrhizal symbionts of ponderosa pine.

Diseases of honeylocust: etiology and biology

Honeylocust was extensively planted in windbreaks in the central and southern Great Plains during the Prairie States Forestry Project (1935-1942). In recent years honeylocust has been widely used in landscape plantings, especially in urban areas where American elms have been killed by phloem necrosis and Ceratocystis ulmi. Damage to honeylocust by pathogens and insects is becoming increasingly serious in windbreak, energy, wildlife, and urban plantings in the Great Plains. A study has been initiated to determine etiology and biology of honeylocust diseases primarily in Great Plains windbreaks. (J. W. Riffle and G. W. Peterson)

Resistance of Juniperus virginiana to Phomopsis juniperovera

Inoculations of 86 progenies of J. virginiana have been completed using one isolate of P. juniperovera. Final inoculations with a second isolate are in progress. (G. W. Peterson)

Resistance of Juniperus virginiana and J. scopulorum to Cercospora sequoiae var. juniperi

Inoculations of 150 juniper progenies with C. sequoiae var. juniperi were made in the summer of 1982. One-fourth of the trees were inoculated in 1982. A high percentage of the inoculated trees became infected. Additional inoculations were made in 1983 to assure that all trees have a chance to become infected. Infection will be evaluated in the fall of 1983. (G. W. Peterson)

Diplodia pinea blight of pines

Diplodia pinea readily infects new shoots of ponderosa, Scots, Austrian, Mugo, and many other pine species. Under some conditions, the fungus spreads from new shoots to older stem tissues; death of major branches and entire trees may thereby result. We are seeking to determine the conditions which result in infection of older stem tissues. The influence of several stress conditions on infection of older stem tissues is being evaluated. (G. W. Peterson)

Resistance to Dothistroma pini in Austrian pine progenies

Austrian pine progenies from trees highly resistant, moderately resistant, and highly susceptible to Dothistroma pini were field planted in 1979 and inoculated with D. pini in 1980 and 1982. Infection was evaluated in 1982. The fungus is now widespread in the planting. The evaluations to be made in the fall of 1983 should provide definitive information regarding inheritance of resistance to D. pini in Austrian pine. (G. W. Peterson)

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Activities of Coop. State Research Service (Trends)

W. K. Murphy

The Cooperative State Research Service (CSRS) has, among its missions, a monitoring function which includes relaying to interested parties the current agricultural and forestry research scene, where it has been, is and where it may be headed. This presentation is an attempt to predict future research directions by analyzing past and present research accomplishments. The Department of Agriculture, through its inputs from many resources has defined five areas of research thrusts that have a high priority. Among these are three that impact on Great Plains forestry, as follows: water management, sustaining soil productivity and, forest and range productivity enhancement. The other two are concerned with human nutrition and developing export markets.

Water is extremely important to much of the Great Plains, but it does not dominate the research efforts in Great Plains forestry. Its importance is exemplified by the recent media attention to clear-cutting aspen to increase runoff in the Rockies. The issue has developed into another emotion-driven campaign because fall foliage will be sacrificed. The headline was "Aspenglow Dims, Washington Post, June 12, 1983. The unstated research base behind the cutting of aspen was that transpiration would be reduced, therefore, more water would be available for consumption. No study was referred to that showed that the water to be gained because of the absence of aspens would flow to the streams. One assumes that the water would be available for movement to the stream. Is it? This example suggests we researchers have to assure the public that we are capable of intelligently studying natural resources and are working for the total public good.

A recurring comment about forestry research is that we are not working at the frontier of knowledge--that basic science is not practiced by those associated with forest and rangeland research. This perception of us by others has some validity, but like all generalizations it lacks the specifics necessary for adequate response. The effort in federally sponsored research is to provide the underlying research needed to solve the problems facing the practitioners.

The studies which examine the efficacy of herbicides or fertilizers are an example of those vulnerable to critical review. Why initiate such studies unless an objective is to determine the mechanisms underlying the results? A report that A is better than B with a statistical assurance of 95 or 99 or 99.9 percent, is the type of result that will not enhance our position as researchers. A legitimate question is--why don't the commercial interests support such studies? Who benefits? An answer, of course, is that our clientele will benefit, provided the results are applicable to perceived needs by that clientele.

In order to discuss trends we must establish a base from which projections can be made. For our study, the current research information system (CRIS) was searched for Great Plains forestry. It produced some extraneous material, but for the most part research progress submitted to CRIS in 1982 is included in the base presented here. The research can be classified into groups dealing with modeling, watersheds, tree improvement, and shelterbelts.

Modeling of ecosystems is a continuing exercise that is dependent on data and verification of the model. It is these data that are needed to assure valid models from which future management decisions can be made. The effort in schools and departments receiving McIntire-Stennis funds in FY 71 was 1.7 scientific years (SY's) and $253,125. Models of small watersheds can be extremely important to planning. Model of the efficiency of water use by reparian vegetation are needed.

The modeling of marginal lands has important connotations providing such models are verifiable. The production of a model in itself has little impact unless its limitations can can be described in terms that other researchers or planners can use. One valid criticism of our work is its applicability. If one cannot test the sensitivity of the model system, one cannot determine the impact of the output of the model. While modeling seems sophisticated, the actual "grunt" work may create the payoffs. The modeling of marginal lands may require someone at sometime to plant a tree or seed a range. We may be overly impressed by emerging technologies and miss the information needed. In establishing vegetation on marginal or strip-mined land one finally has to plant, record, evaluate and report. The hard work must be done. The meld between the two must be assured by including sufficient variables and their interactions in the model and by recording sufficient data in the field. Neither of these exercises is inexpensive but they both are required to provide the information needed.

Erosion is another of the priority items for research emphasis. In some projects that could be considered Great Plains forestry much of the erosion research is in conjunction with drastically disturbed soils. Little research is being done in the Great Plains in erosion control with 1.9 SY's and $106,822 allocated, and yet the major reason for windbreaks is to control erosion.

The majority of research in forestry and range can be broken down into three categories: Tree and range improvement, insects and disease, and shelterbelts. Each of these includes portion of one or both of the others.

The work on shelterbelts is, of course, one of long standing. Such research continues to be of importance. The buzz words now include "energy" and "biomass". Thus, we see studies of biomass for energy from shelterbelts. A few studies in energy conservation affected by windbreaks and one study on the effects of windbreaks on crops (soybeans) are reported. Direct expenditures for shelterbelt research in the McIntire-Stennis program are $292,466 and 2.1 SY's.

Tree improvement research varies in scope from tissue culture to provenance tests, from christmas trees to drought resistant forest trees. Studies specifically aimed at windbreaks continue, as do studies of insect and disease resistance, fall coloration, needle coloration, energy content, wood quality, and growth and yield.

The recognition that trees planted in windbreaks may be specific phenotypes has led to many studies in the improvement of these windbreaks by tree selection. "Aspenglow" is among such studies form the standpoint of fall coloration of specific clones. Provenance tests of various species

continue to dominate much of the reporting of results of continuing studies. The wide range of species in these tests is impressive. The effort expended through the McIntire-Stennis program is 2.4 SY's and $275,447.

Another area of extensive work is in the insect and disease susceptibility of woody plants, particularly those used in shelterbelts. Such research is generally carried on outside of the McIntire-Stennis program departments although some research is supported by McIntire-Stennis funds amounting to $107,661 and 1.6 SY's.

The main purpose of the foregoing has been to define a base, and thus serve as an introduction. The talk is to be about trends in Great Plains Research as I see them through my crystal ball. The push is for fundamental research, however that is defined. A component of McIntire-Stennis funding is the education of scientists. Those programs with doctoral studies should, by definition, be working at the "frontiers of knowledge". Where are these frontiers? Biotechnology and bio-regulation are the new buzz words. Surprisingly, we in the natural resources have been working in this area for a long time.

The work with biological systems has been limited by the set genetic makeup of the organisms making up that biological system. Biotechnology is defined as the technological use of biological agents, and as such is more than genetic engineering, although genetic engineering is the forerunner of much of the publicity associated with biotechnology. The shortcuts offered by genetic engineering are attractive, particularly to those working with trees. Problems with tissue culture exist, among them are genetic instability, tissue differentiations and regeneration of plantlets.

Tissue growth has been shown to be effective in predicting progency growth in Populus and loblolly pine in field studies. Traits such as photosynthetic efficiency, stress tolerances, resistance to diseases, frost, drought and herbicides, etc., can be screened in tissue culture.

The establishment of some species of trees has been enhanced by the introduction of mycorrhizae into the soil. The association of fungi and tree species may encourage shelterbelts in drastically disturbed sites or in sites where high stress potential exists.

Bio-technology can play an important role in the development of biological control agents of insect pests. Bacillus thuringiensis (B.T.) has been effective in the control of the Gypsy moth. Other microbial insecticides are available. The Italian demonstration of a virus that weakens or kills chestnut blight fungus is one that holds much promise for biological control of pathogens.

Mentioned in the presentation was the emphasis on water and erosion. Both of these research areas are within the provenance of Great Plains forestry. Research into the conservation of both water and soil as well as the utilization of water by trees will continue to be active topics.

Energy is of decreasing importance in the short run. Those who look at funding don't seem to recognize that oil and gas are finite resources. In the long run research in energy conservation, wood chemistry, effects of shelterbelts on adjacent homes and crops, and wood as fuel can be anticipated.

A thrust that is gaining momentum is export trade. One wonders how Great Plains forestry can be active in the export market yet the riparian forest may be ideal for such markets. High quality trees of species now traded internationally could be grown adjacent to streams. Harvesting of such trees is much easier during specific times of the year than of their counterparts in the traditional forests.

Finally, the research direction in renewable resources is toward basic studies. While pragmatic research may pay the yearly bill, the extension of basic studies into the future requirements of the resource is badly needed. The statement that has attracted attention is that we continue to draw from the reserve of fundamental knowledge while adding little to that reservoir, is true. In our enthusiasm to answer pending practical problems, we have neglected the underlying science. Although each of us has a clientele that needs immediate response, we also have a responsibility to future researchers to establish bases for their work.

Diseases of Siberian Elm and Russian Olive in the Northern Great Plains

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Siberian elm - Siberian elm, Ulmus pumila L., has been widely planted in windbreaks in the northern Great Plains. In 1979, Siberian elm cankers were collected from trees in eight windbreaks from five counties of northeastern Montana, in seven windbreaks from six counties of western Minnesota, in eleven windbreaks from nine counties of northeastern South Dakota, and in 58 windbreaks from 36 counties of North Dakota[1/]. The area encompassed included 56 counties and is representative of the Siberian elm windbreak plantings in the northern Great Plains. Cankers were classified as: i) small branch cankers - on branches less than 2.5 cm in diameter; ii) large branch cankers - on branches between 2.5 and 12.5 cm in diameter; and iii) basal cankers - located on the lower main trunks of recently killed trees.

Isolations were made from 609 cankers. Of these, 66% were small branch cankers, 29% were basal cankers, and 5% were large branch cankers. The 528 cankers from which either Botryodiplodia hypodermia (Sacc.) Petr. and Syd., Tubercularia ulmea Carter, or Cytospora sp. were isolated, account for 87% of the cankers processed. Within this group of cankers, comparisons can be made between the fungi isolated and the type of cankers from which they were isolated. Forty-six percent of B. hypodermia isolations, 16% of the T. ulmea isolations, and 10% of the Cytospora sp. isolations were from basal cankers. Forty-eight percent of B. hypodermia isolations, 82% of the T. ulmea isolations, and 88% of the Cytospora sp. isolations were from small branch cankers. Thus over 80% of the T. ulmea and Cytospora sp. isolations were from small branch cankers while B. hypodermia was isolated almost equally from small branch and basal cankers.

This study confirmed the presence of B. hypodermia and T. ulmea in windbreak trees over a larger area than previously reported. Because the survey covered areas of major windbreak plantings, the results indicate a high probability of finding Siberian elm cankers wherever Siberian elm windbreaks are located in the northern Great Plains. Although several different fungi were isolated, B. hypodermia and T. ulmea were the only fungi capable of producing cankers under our conditions, and they were isolated from cankers from 88 and 59 percent of the counties for which cankers were processed.

Growth and spore production of B. hypodermia were determined on different culture media[2/]. Growth and spore production were greatest on potato dextrose agar-Difco (PDA-D) or potato dextrose agar-"home made" (PDA-L) followed by yeast malt extract agar (YMA) and V-8 juice agar (V-8A). Growth and spore production were best at 25±1C for PDA-D and PDA-L, while 21±1C was the optimum temperature for V-8A. Sterile wheat kernels added to the surface of these media promoted additional growth and conidial production and provided a convenient inoculum for inoculations.

Variation in spore type and virulence of 218 isolates of B. hypodermia was examined (3). Seven percent of these isolates were considered to be atypical. Typical and atypical isolates of B. hypodermia were compared in five inoculation studies in the glasshouse and three inoculation studies in the field. Overall five atypical and 14 typical isolates from 16 counties in four states (North Dakota, South Dakota, Montana, Minnesota) were used in these studies. Fifty-one percent of 240 branches inoculated in the glasshouse were dead above the point of inoculation. Only 16% of 80 branches inoculated with atypical isolates were dead, but 69% of 160 branches inoculated with typical isolates were dead. Sixty-three percent of the field inoculated branches were dead above the point of inoculation. Only 29% of the 52 branches inoculated with atypical isolates were dead, but 80% of the 106 inoculated with typical isolates were dead.

In both glasshouse and field studies the atypical isolates of B. hypodermia consistently caused less disease development on Siberian elm seedlings than did typical isolates. Only 20% of 132 branches inoculated with atypical isolates were dead above the point of inoculation compared with 73% of the 266 branches inoculated with typical isolates. Thus atypical isolates should not be used when screening germplasm for resistance. Because there is some variation in virulence among typical isolates, several typical isolates should be used to evaluate U. pumila germplasm for resistance.

Russian-olive - Russian-olive, Elaegnus augustifolia L., has been widely planted in windbreaks in the northern Great Plains. Unfortunately, canker diseases can be a problem that contributes to the decline of Russian-olive windbreaks. During 1978-82, 364 cankers were collected from diseased Russian-olive trees in 34 counties in North Dakota and South Dakota. Preliminary data indicate that cankers were caused by Tubercularia ulmea, Botryodiploidia theobromae Pat., and Phomopsis elaeagni (Carter and Sacamano) Arnold and Carter. Of the 34 counties where cankers were collected, preliminary data indicate the presence of T. ulmea, B. theobromae, and P. elaeagni in 76, 29, and 12% of the counties sampled. Thus Tubercularia ulmea appears to be the most common type of organism associated with cankers on Russian-olive trees in the northern Great Plains. No previous reports of cankers caused by B. theobromae and P. elaeagni on Russian-olive in the northern Great Plains have been found.

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Thyronectria Canker of Honeylocust

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In recent years, honeylocusts (Gledistia triancanthos) have become popular shade and ornamental trees in Colorado. Primarily, this is because of the tree's rapid growth, tolerance of Colorado's climate and the small leaves which produce a diffuse shade which allows for good turf.

A canker disease caused by Thyronectria austro-americana has become a common site in recent years. The disease is found on the east side of the Rocky Mountains in Colorado and is located in most communities that have honeylocusts. We assume the current incidence is about 1%. The disease, however, is either becoming more prevalent, or we are more aware of it since workers in Colorado, Kansas, and Illinois are reporting considerable losses to urban and windbreak trees.

The disease is usually first noticed when part of a tree begins to die back or there is early fall coloration. A basal or branch crotch canker is usually found and death occurs by girdling of the cambium. Death occurs in one-two years after initial symptom expression.

The fungus profusely forms pycnidia and occasionally perithecia on cankered areas of the tree. The cankers are usually not very visible since many times they are not sunken and the fruiting bodies stick out through lenticels so they are hard to see. One can look for a reddish to brown stain under infected areas.

The other problem is that Nectria canker (Nectria cinnabarina) looks very similar and is common in Colorado. The best way to distinguish these two fungi is to culture the fungi since Thyronectria has a distinct orange colony. Nectria canker also tends to be less aggressive and more often form sunken cankers.

The fungus produces windblown ascospores and conidia that are probably moved by rain. The involvement of insects is unknown. We don't know when infection can occur and assume that wounds are necessary for the fungus to enter a tree. The main question is why some trees are infected and others not. We assume this to be related to some type of stress on the root system such as oxygen or drought stress or root rots.

Our current research activities are looking at certain aspects of the disease in the tree and basic physiology of the fungus. We have a 500 tree nursery with five cultivars of honeylocust established and will be using them for a variety of experiments including determining if any of the cultivars are resistant.

Field observations of diseased trees by myself and cooperators are key punched from a standard form. We are looking for trends in canker, tree, and site information that might give some hints as to why certain trees are attacked. So far about 50% of the sick or dead trees we've observed are attacked by Thyronectria, the others are too dead to determine cause of death or are killed by Nectria. The trees have ranged from twelve to twenty years old, six-twelve inches dbh, and twenty to thirty feet tall. Tree dissection and culture work has indicated that: basal cankers girdle in one to three years; the fungus grows radially into the tree; verticle growth past the canker margin is limited; both Thyronectria and Nectria can be found on a tree but both can kill by themselves; and if both are present Thyronectria appears to be the initial invader.

A preliminary study of how long wounds remain viable infection counts suggested that they are susceptible for at lease two months but infection is reduced over what a fresh wound would allow.

We have also studied the effects of nutritional and environmental factors on in vitro fungal growth, spore release from pycnidia and spore germination to get a better idea of how this fungus functions.

The fungus grows over a wide range of temperatures, 10-40°C with the optimal growth at 25-30°C. Growth over a wide range of temperatures is probably very beneficial to the fungus in Colorado's climate.

The fungus grew well on all carbon sources tested except for sorbose and grew the best on the following nitrogen sources--glutamic acid, casamino acid, ammonium tartrate and asparagine.

Spore release from natural pycnidia is very rapid (10-40 sec) when free water is added. Spore release occurs rapidly at 5-40°C and even after freezing at -15°C for eight months or being stored at room temperature for a year. No spore release occurred at less than 100% relative humidity. Thus pycnidia appear very durable sources of inoculum and probably require rain for spore release.

The germination of the spores was assessed under various conditions to determine what type of environment is required for germination and thus presumably infection. Germination was enhanced by the presence of carbon and nitrogen compounds and by water extracts of honeylocust wood. The best germination was at 25-35°C with inhibition at 10° and 40°C. The effect of relative humidity on germination was impressive. Germination occurred at 100%-75% RH and at 96-75% the germination was just delayed not inhibited. No germination occurred at 62% RH.

In conclusion, we have found the fungus apparently well adapted to a wide range of nutritional and environmental conditions that allows it to attack trees from Massachusetts to Colorado.

In the future we hope to focus on drought and oxygen stress of roots as possible stress factors that allow Thyronectria to attack honeylocusts.

Canker-rot caused by *Phellinus punctatus* on woody plants in North Dakota

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Shelterbelts remain important in North Dakota and several organizations are involved in working with them. One part of the shelterbelt research project at North Dakota State University involves the study of shelterbelt diseases. Little information is available concerning incidence and distribution of diseases of shelterbelts in the Northern Plains. Therefore, surveys to determine which diseases are most important in shelterbelts have been part of our study.

The major part of three field seasons, 1979-1981, involved a disease survey during which over 500 sites with woody plants in nine North Dakota counties were examined. The survey was designed to detect the most prevalent diseases and/or fungi in the sites examined. The counties surveyed were selected as representative of the entire state. At each site a standard form was used to record site factors and information about plants and plant diseases present. As many types of sites with woody plants that could be found in each county were examined, including field shelterbelts, farmstead windbreaks, and native stands.

A 1978 survey was designed to determine the incidence and distribution of *Fomes fraxinophilus* stem decay of green ash in Prairie States Forestry Project shelterbelts. Information on other decay fungi on green ash was recorded and the survey was repeated in 1982.

One of the fungi found in these surveys was *Phellinus punctatus* (Fr.) Pilat. It causes a canker-rot, that is, an expanding dead area in the bark of a live plant and a decay of the wood. The fungus causes a white rot of the wood. Stems with canker-rot appear to be infected through branch stubs. The canker symptom is not always present, especially on dead plants.

In a review of the literature, it was found that *P. punctatus* had been collected in North Dakota as early as 1916. Either the hosts were reported to be dead or no indication was given as to condition of the host. In addition, there is no report of *P. punctatus* occurring on live hosts anywhere in North America. In contrast, it commonly occurs on live hosts in North Dakota.

All information presented here concerning distribution and incidence of *P. punctatus* is based on the presence of sporocarps on trees. Because of this, the information likely underestimates the actual incidence due to three factors: 1) not observing all trees at each site; 2) not noticing or recognizing the fungus on trees observed; and 3) not being able to detect infected trees where no symptoms were apparent. Amount of the likely underestimate is not known.

Sporocarps of P. punctatus were observed on caragana (Caragana arborescena Lam.), green ash (Fraxinus pennsylvanica Marsh.), American plum (Prunus americana Marsh.), chokecherry (P. virginiana L.), common buckthorn (Rhamnus cathartica L.), white willow (Salix alba L.), diamond willow (S. missouriensis Bebb.), and common lilac (Syringa vulgaris L.). Phellinus punctatus was observed on live and dead plants of each of these hosts except chokecherry and white willow, where it was observed only on dead plants.

Phillinus punctatus has been found in eleven counties. It was not found in two southwest counties surveyed. Age of plants on which P. punctatus was found ranged from 21 year old American plum to ca. 90 year old green ash. Known host species greater than 20 years old were found in 227 of the sites surveyed. Sporocarps of P. punctatus were found at 36% of the 227 sites. It was observed at many more sites (74 compared to 8) and on a higher percentage of sites (55 compared to 9) having hosts greater than 20 years old in eastern counties than in western counties. P. punctatus was found more often on each host in eastern counties than in western counties. Sporocarps were found most often on green ash. The highest percentage incidence was on diamond willow (43% of 7 sites), followed closely by green ash (38% of 189 sites). This data has been submitted for publication[1/]

Data on incidence of P. punctatus within a host species is available only for green ash in Prairie States Forestry Project shelterbelts. In 1978, P. punctatus sporocarps were found in 43% of the 30 shelterbelts and on .01% of 25,558 live green ash examined. In 1982, when the same shelterbelts were resurveyed, P. punctatus sporocarps were found in 100% of 29 shelterbelts and on 3.6% of 24,730 live green ash examined. This data has been submitted for publication[2/].

Discussion

In North Dakota, Phellinus punctatus is widespread, has a wide host range, and is common on some live hosts. The occurrence of P. punctatus on live hosts is important, as it had previously been reported only on dead hosts in North America. Based on sporocarp occurrence, this is one of the most important stem decay fungi in North Dakota.

Amount of damage caused by P. punctatus in terms of volume of decay, growth loss, or number of broken stems is not known. Wood in the stems is rotted and stems broken at cankers were observed, so some damage is apparent. These losses remain to be quantified.

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An Aphid Pest of Honeysuckle

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Honeysuckle (Lonicera spp.) is widely used in Nebraska landscaping but its major use has been in wildlife plantings, as understory plants in windbreaks, and as living snowfences along highways. Until recently insects have not been a problem, but the sudden appearance on honeysuckle of an aphid that causes obvious and rather dramatic damage in the form of a witches' broom has altered our belief in the "pest-free" reputation of this plant.

The aphid, Hyadaphis tataricae (Aizenberg) has had only a brief history in North America. It was first reported in Quebec Province, Canada in 1981. It apparently had been present for 5 or 6 years, possibly having been introduced on nursery stock from Europe (Boisert, Cloutier and McNeil 1981). The aphid is widely distributed in eastern Europe, but probably is of Asian origin (Voegtlin 1982). It is less than 2 mm long with short cornicles, and varies from cream to pale green. There are no obvious distinguishing markings. It is often lightly covered with a white, powdery flocculence which is especially noticable in older forms. A summary of its life cycle, distribution and its effect upon honeysuckle was published by Jones (1983).

In the fall of 1979, a state horticulture inspector observed the witches' brooms on honeysuckle in an Illinois nursery. No aphids were present on the samples, but the following year the aphid was identified and it was found in 5 northeastern Illinois counties, in northwestern Indiana and at Madison, Wisconsin (Voegtlin 1981). Since it occurred on nursery stock, state horticultural inspectors through the midwest were alerted. By the fall of 1981 the aphid had been found in one or more locations in Illinois, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa and Nebraska. By the fall of 1982 horticulture inspectors of the Nebraska Department of Agriculture had reported the aphid present in 14 eastern Nebraska counties.

This spring we began a statewide survey for the aphid. This survey is far from complete, but we think the distribution pattern is beginning to emerge. The aphid is abundant throughout the eastern third of the state. As one moves westward it becomes less abundant, but so does honeysuckle, and we have not yet found it in the western third of the state. However, at the rate it is spreading, we expect it will eventually occur wherever there is honeysuckle in Nebraska.

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In Europe this aphid occurs only on Lonicera spp. (Grigorov 1965) and, as far as we now know, that is the case in North America. However, not all species and varieties appear equally susceptible and the search for resistant varieties is already underway (Mainquist et al 1982; Lewis 1983). In Nebraska the three most commonly planted honeysuckle varieties, Tatarian, Zabel and Morrowii, are highly susceptible. A vine type, L. japonica var. Halls, is used rather extensively as ground cover. We have not found the aphid damaging this type.

The aphid usually feeds on the upper surface of the leaves, preferring succulent new growth. It causes the leaves to fold upward along the midvein and the leaves are stunted. Secondary buds are stimulated to grow and there is shortening of the internodes. The result is a characteristic witches' broom of many small, often crooked twigs bearing stunted, folded and curled leaves. The foliage on the brooms dies earlier in the fall than the uninfested foliage and persists longer. The witches' brooms are easily seen during winter.

The limited literature on the aphid indicates that these witches' brooms usually die during the winter (Grigorov 1965, Boisvert et al. 1981), but this was not generally true in Nebraska this past winter. Most witches' brooms survived the winter and produced new growth this spring. We suspect, from limited observations, that brooms formed late in the year fail to harden off. These die while those that do harden off survive. If this proves correct, the aphid might not be as injurious as commonly thought from the extensive disfigurement of affected plants.

In Europe, the aphid's overwintering eggs are deposited at the base of buds and on the dead leaves within the witches' brooms (Grigorov 1965). Last winter we carefully examined countless witches' brooms but found very few eggs. It remains to be seen if this is due to our technique or if the aphid deposits most eggs somewhere other than the witches' brooms. In any case, the eggs hatch in early spring and the aphid multiplies rapidly. Every 10 days we examined 4 witches brooms from each of 4 sites around Lincoln. The first aphids, a total of 7, were found on April 16 when leaves first appeared. On April 26, our 16 brooms yielded a total of 93 aphids. On May 6 we found 221 and on May 16 the number rose of 2272. This included 18 winged forms and winged forms have been found in every sample since May 16.

After May 16 we examined the new growth rather than the old witches' brooms. Each week at each site, we took the terminal 3 inches from 40 actively growing shoots. These were placed in small Berlese funnels and the aphids were collected in alcohol. Our first such collection, May 23, produced 5,100 aphids. For June 6, we had an excess of 50,000 aphids. When the population is this high, many aphids are found outside the folded leaves. They occur on the undersides of the leaves, on the leaf petioles and the stems. But young succulent foliage remains the preferred site and relatively few are found on the older, tougher leaves.

The number of aphids per sample has been declining since late June. Grigorov (1965) found aphid populations were depressed in late July and August and in the autumn their numbers again increased. We expect to observe a similar cycle. Casual observations last September and October revealed populations as high as any we have found this year.

This spring we began screening insecticides to control the aphid. No insecticide label mentions this specific aphid, of course. Thus, we are testing common insecticides registered for use on one or more deciduous trees or shrubs and labelled for use against aphids. We are screening several systemic and non-systemic organo-phosphates and a carbamate as foliar sprays at labelled rates of application. Although tests are not complete, preliminary results indicate that systemic chemicals may afford better protection. This is not surprising considering the protection offered the aphid by the folded leaves. We have not seen any phyto-toxicity in any of our tests.

Tests to date indicate chemical control will be fairly easy to achieve with insecticides. The presence of winged forms during much of the year assures constant re-infestation. Thus applications may be necessary throughout the growing season. We are attempting to determine the number and timing of treatments needed to protect the plants from insect injury.

Lastly we applied liquid and granular formulations of organophosphates to the soil around honeysuckle plants. This approach to aphid control will be evaluated in early fall.

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Genetic Improvement of Trees and Shrubs by the Northern Great Plains Research Laboratory

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Abstract:--The genetic research program for tree and shrub species at the Northern Great Plains Research Laboratory is developing improved cultivars for planting in windbreaks and other conservation plantings. Two major genera--Ulmas and Populus receive the most emphasis. Less intensive efforts involve Fraxinus, Juniperus, Celtis and Pinus species. For most species, traits to be improved include: hardiness, pest and herbicide tolerance, growth rate, crown form and competition with crops. Strategies being used to improve each species are described and the progress to date is reported.

Additional Keywords: provenance tests, pest resistance, Ulmus pumila, Populus, Fraxinus pennsylvanica, Pinus sylvestris, Juniperus, Celtis occidentalis.

The goal of the genetic research program for windbreak species at the Northern Great Plains Research Laboratory is to develop improved tree and shrub cultivars for planting in windbreaks, wildlife plantings and other types of conservation plantings. For most species, traits to be improved include: hardiness, pest and herbicide tolerance, growth rate, crown form, and competition with crops. The majority of our time, effort and money are presently being spent on two major genera--Ulmus and Populus. Less intensive efforts involve, Pinus, Fraxinus, Juniperus, and Celtis species. We expect that over time there will be changes in emphasis as the work with various species reaches different stages of selection, testing and breeding. In the following discussion I will briefly explain why we are working on each species and what we are doing to improve them.

Ulmus--Siberian elm (Ulmus pumila, L.) has long been a favorite species for planting in both field and farmstead windbreaks. Its rapid early growth, drought tolerance, and ease of establishment are the primary reasons for its popularity. In recent years, however, the planting of Siberian elm has decreased due to problems contributing to a general decline in vigor. Winterkill, herbicide damage, stem cankers, wind and snow breakage, and cankerworm defoliation have combined to cause extensive mortality in many area of the Great Plains.

Our strategy for improving this species involves utilizing genetic variation within Siberian elm as well as variation among hybrids of U. pumila, U. rubra and U. japonica. Superior phenotypes of Siberian elm are being selected within the windbreaks in North Dakota and South Dakota. So far most selections have been for cankerworm resistance, stem canker resistance and good crown form. About 146 selections of this type have been made to date. Additional accessions of U. pumila x U. rubra hybrids and U. japonica have been acquired from various universities and

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government research agencies. Most of the selected phenotypes and accessions have been vegetatively propagated by softwood cuttings and are established in stool beds at the Mandan Laboratory. The cankerworm resistance of each clone is being evaluated in cooperation with Dr. Mary Ellen Dix, U.S. Forest Service, Lincoln, Nebraska. Dr. Dix is conducting laboratory feeding preference trials using rooted cuttings of clones that have been grown in the greenhouse. Of the 45 clones that have been screened so far, 4 clones appear to have useful levels of resistance. Evaluation of disease resistance is being conducted in cooperation with Dr. Joe Krupinsky at the Mandan Laboratory. Botryodiplodia hypodermia (Sacc.) Petr. and Syd. and Tubercularia ulmae (Carter) appear to be the most serious diseases of Siberian elm in the northern Great Plains. Greenhouse-grown ramets of each clone are being inoculated with pure cultures of fungi that Dr. Krupinsky has isolated from diseased trees in windbreaks in both Dakotas. All of the clones that demonstrate useful levels of insect or disease resistance will be planted in field trials to determine how well their resistance holds up under field conditions. Concurrently with the establishment of the field trials, an experimental seed orchard will be established with clones that are potentially superior in one or more traits. Seed produced in this seed orchard will be made available to nurserymen as an interim source of improved seed. As the results of the field trials and pest screening become available, clones can be removed or added to the seed orchard to upgrade its genetic quality. Once clones have been identified as having alleles favorable for one or more traits a breeding program will be initiated to combine these traits into a superior cultivar.

Populus--Plains cottonwood, Populus deltoides var. occidentalis Rydb., and several of the hybrid poplars that have been planted for a number of years throughout the Great Plains are very fast growing and very tall trees. Experience has shown that Populus is quite site-sensitive and there are numerous examples of off-site plantings. Droughty sites and/or fine-textured soils generally are poor choices for Populus. Stem cankers that eventually girdle the main stem and kill the tree are common on off-site plantings. The organisms associated with stem cankers can include species of Septoria, Cytospora, Phomopsis or Dothichiza. A leaf rust, Melampsora medusae Thum, is a serious pest on many poplar clones from southern South Dakota south to Texas. One poplar clone, P. deltoides 'Siouxland' was selected for its resistance to leaf rust. Leaf spot diseases of poplars can be caused by species of Septoria, Marsonina, Septotinia and Phyllosticta. Other clones in common use such as P. deltoides x P. balsamifera 'Northwest' are very susceptible to Melampsora leaf rust. A major insect pest is the poplar bud gall mite that often results in entire trees being covered with unsightly galls. Our selection objectives for Populus include: increased adaptability to problem sites; stem canker and leaf rust resistance; and poplar bud gall mite resistance. Our strategy for improving Populus takes advantage of the ease of vegetative propagation that most species offer. Rooting hardwood cuttings permits the rapid, economical propagation of many ramets of each clone.

About 170 clones of Populus species and hybrids have been assembled in our stool beds at Mandan. Most of the clones were furnished by nurseries, universities, and federal research agencies. Several clones of the native

Plains cottonwood have been selected along the Missouri River south of Mandan. Screening for disease resistance has been initiated in cooperation with Dr. Joe Krupinsky. Cultures of Septoria musiva Peck., isolated from windbreak trees are being used to inoculate rooted cuttings. The subsequent development of leaf spots and/or the development of stem cankers is permitting us to rate the degree of resistance of each clone. As with the elms, clones that perform well in the greenhouse screening trials will be field tested to examine the correlation between greenhouse and field performance. When five to ten clones have been identified as superior in greenhouse trials they will be released to nurserymen as a clonal mixture. Trial plantings of these clonal mixtures will be evaluated for their compatibility and performance. As additional information on each clone is accumulated, the clones constituting the mixture will be changed to meet the requirements of different planting sites. Clones that consistently perform poorly will be dropped from the mixture and new clones will be substituted for them.

Juniperus--Rocky Mountain Juniper, Juniperus scopulorum Sarg. and eastern red cedar, J. Virginiana L. are planted in greater numbers in the Great Plains then any other conifer. Their high rate of survival, drought tolerance and wide range of site tolerance make them an excellent choice for a variety of uses, ranging from windbreaks and wildlife habitat to barriers for noise reduction, visual screening and living snow fences. Faster growth, better form and a reduced propensity to volunteer are improvements most needed. A cooperative provenance test of Juniperus species in the Great Plains has been established by Technical Committee, GP-13, of the Great Plains Agricultural Council. We have a cooperative test plantation at Mandan that includes 144 provenances planted in five replications. Fifth-year data will be collected this fall and the results should help describe the extent of genetic variation within these species and identify the best provenances for particular planting sites. Superior phenotypes will be selected, vegetatively propagated and assembled into a cooperative seed orchard to be managed by the North Dakota Forest Service. A breeding program to combine the best traits of selected phenotypes is in our long-range plans.

Celtis--A cooperative provenance test of hackberry, Celtis occidentialis L. has been initiated by the GP-13 Technical Committee. The procedure being used is modeled after that used in the Juniper study. Seed collections will sample the western and northern portion of hackberry's native range. A total of 275 seed collections are planned in nine states and one Canadian province. Fifty-eight of the collections were completed in 1982. The planting stock will be grown at the USDA-Soil Conservation Service's Plant Materials Centers in Manhattan, Kansas and Bismarck, North Dakota. We hope to establish at lease one test plantation in each of the states sampled. A test plantation is planned for Mandan.

Earlier efforts at Mandan by the late Dr. Ernie George to improve hackberry have resulted in the release of a new hackberry cultivar. 'Oahe' has been released cooperatively by the USDA-Soil Conservation Service and USDA-Agricultural Research Service. 'Oahe' was developed at ARS's Northern Great Plains Research Laboratory and tests by SCS's Plant Materials Center, Bismarck, and at other sites in the northern Great Plains. 'Oahe' is a seed propagated cultivar recommended for use as a medium to large tree in farmstead and field windbreaks, and wildlife and

natural area plantings. 'Oahe' differs from common hackberry in its increased rate of survival and growth. 'Oahe' is recommended for planting within most of North Dakota and South Dakota. The release of 'Oahe' marks the first time a hackberry cultivar has been released for use in the conservation plantings.

Fraxinus--Green ash, Fraxinus pennsylvanica Marsh. has supplanted Siberian elm as the favorite hardwood species for windbreak planting in the Northern Plains. High rates of survival and a lack of serious pests have contributed to its popularity. Concerns are being expressed by foresters in the northern Great Plains about the "monoculture" that is developing as a result of green ash's popularity. Development of a serious pest problem in this species could result in the loss of thousands of acres of windbreaks, much as has happened to Siberian elm. Because of these concerns the United States Forest Service Shelterbelt Lab formerly located at Bottineau, North Dakota established a provenance test of green ash collected from native green ash growing in Montana, North Dakota, South Dakota and Nebraska. Thirty-three origins were collected. Test plantations containing 20 replications of each origin were established in Bottineau and Mandan, North Dakota, Watertown, South Dakota and Alliance, Nebraska. Fifth-year data will be collected in the fall of 1983 and a regional publication will be prepared.

Pinus--At the present time only two pine species are planted in windbreaks in the northern Great Plains--ponderosa pine (P. ponderosa Dougl. ex Laws.) and Scots pine (P. sylvestris L.). Additional pine species are needed to increase species diversity. Lodgepole pine, Pinus contorta var. latifolia Engelm. ex S. Wats., has the potential for such a role, but little is known about suitable provenances for use in the Great Plains. To help obtain such information a provenance test of 25 origins collected in British Columbia, Alberta, Montana, Wyoming and Colorado was established at Mandan in 1980. Initial growth has been slow, but in the past year the growth rate of many origins has increased and considerable variation is becoming evident.

A full-sib progeny test of controlled-matings among selected phenotypes within a Scots pine provenance test at Denbigh Experimental Forest was established by the Forest Service Shelterbelt Lab in 1979. Thirty full-sib families, replicated twenty times in 2-tree plots were planted at Bottineau and Mandan, North Dakota; Watertown, South Dakota; and Alliance, Nebraska. The purpose of the progeny test is to evaluate the genetic worth of the original selections and to provide germplasm for future selection. Fifth-year data will be collected in the fall of 1983 and a regional publication will be prepared.

Future Work--As the supply of money, time and manpower permits, future research at Mandan will be expanded to include the following projects:

1. Provenance tests - bur oak, honeylocust;
2. Tissue culture - hackberry, honeylocust, bur oak, pines;
3. Isoenzyme analysis - elms, poplars, junipers.

Height Growth of Ponderosa Pine Seed Provenance in Plains Plantations

Ralph A. Read
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It is with a great deal of pleasure and satisfaction, I might add, that I have the opportunity to present the results of this study. After all it's not often that a researcher in forestry can start a study, over 20 years ago, and stay with it through the first important period of development. This is a report on the performance of 79 seed provenances of ponderosa pine, after 10 years testing in 17 well-scattered field plantations.

In the Great Plains region, ponderosa pine once established, has shown itself to be a very hardy and useful tree for windbreaks and other protection plantings. It does have some faults, as does every other tree, however. It is susceptible to a host of insect and disease pests, and its height growth can be strongly erratic.

For those and other reasons, we decided back in 1960, to learn something about its genetic variations over the large range of easternmost natural stands. Mainly because little or no research information was available about these eastern populations, which had been used for the Plains plantings. Hans Neinstaedt, geneticist at the Northcentral Experiment Station, Rhinelander, Wisconsin initiated the plan, with the help of Dave Dawson in North Dakota and myself of the Rocky Mountain Station.

We started the study in 1962, collecting cones from the natural stands for 3 years running, in order to get enough seed for a large study. We first plotted out roughly the coverage for collections, including most of the outlier stands in the area between the Plains and the Mountains. We also included stands in the Front Range, the Bighorns, the Black Hills, and central Montana. We included 4 stands in the Bitterroot Valley, and for good measure a stand each from Idaho, Washington, Oregon, California and Arizona. Except for these last five which were received from cooperators as composite stand collections, we picked cones from 10 to 15 average trees in each stand to represent each location; but keeping the individual tree lots separate. Dave Dawson at Bottineau, North Dakota made all collections from the Black Hills northward, and yours truly made all collections south of the Black Hills.

We sowed the seed at two nurseries: Towner, North Dakota and Bessey, Nebraska in spring 1965. Before sowing however, we made composites of each stand collection by mixing seed of the 10 to 15 trees. We grew the seedlings for 2 years, then transplanted them for one more year. Seedlings for each location were grown not only in large production beds for the field test plantations, but also in 10 replicated nursery beds for measurement of seedling traits over the three year study period. A report on the seedling research which contains a great deal of detail, is available in this Forest Science Monograph, copies of which are available for those who wish them.

In spring 1968 we dug and shipped planting stock to field cooperators. From Bessey, Nebraska nursery we shipped bales of bareroot trees by air freight from North Platte, Nebraska. Trees from North Dakota were sent by ground transportation. We followed up in 1969 and 1970 by shipping twice transplanted stock to those cooperators needing replants.

All plantations established were replicated. Most were 4-tree plots replicated 15 times. A few cooperators divided their materials to plant fewer replications at several locations. Land was usually carefully prepared, and weed and rodent control was practiced. In spite of the care taken, several plantations were near failures, and those of course are omitted in this analysis.

At this point I wish I had time to acknowledge each and every cooperator and his technicians and graduate students, who were responsible for the excellent work in field establishment. Because had it not been for their planning and diligence, I would have little to report today. You can read their names in the paper I have prepared for publication later this year.

Ten years passed... and those three words do not begin to tell all of the blood, sweat and tears that went into the care and maintenance of plantations... and in the fall of 1977, all plantations were measured for their height growth. That little operation produced over 65,000 individual measurements of survival and height. But help was available for analysis in the name of a talented biometrician at our Rocky Mountain Station, Rudy King. He brought order from all those data.

He first did analyses of variance and multiple range tests for the data of each plantation. Although high significance was shown among seed provenances for each plantation, it separated only the extremes, the tallest versus the shortest. So we took a different tack, and went to the cluster isodata analysis, which we had used for analysis of seedling traits. Only this time we used plantations as the second variable (in place of traits). Taking all plantations and all seed provenances, the cluster analysis by computer minimizes variability among provenances <u>within</u> clusters, while simultaneously maximizing variability <u>among</u> clusters.

In our cluster analysis we used 9 of the 17 plantations; these nine contained the full complement of all provenances. The clustering process involves the grouping of provenances first into two clusters, then 3, and so on, until the analysis reaches a point where no further logical clusters can be separated. Therefore at 6 clusters it appeared we had reached this point. Then Rudy did a discriminant analysis to assess the degree of separation among clusters, and to correct any provenances possibly misclassified. Only two needed to be corrected, and the results are shown on this map. A summary of the cluster means is shown on the handout table. This table presents the survival and mean heights guts of the cluster analysis, but the data to look at in the table are the <u>percent of the plantation means</u>. These allow direct comparison across all plantations, i.e. over a range of site environments, by relating cluster mean heights to each plantation's mean height.

These are the six clusters delineated on the map... Looking first at the Northern plantations on the first page, we see that survival of all Southern cluster provenances was low to zero; pretty much as expected when you move plant materials from New Mexico to Canada.

Next lets concentrate on the Best cluster named Northcentral Nebraska and the Poorest named Central Rocky Mountain. Growth of the NC Nebraska cluster ranged from 107 to 145 percent of the plantation means. On the other hand, growth of the CRM cluster ranged from only 75 to 94 percent of plantation means.

Then, turning to the second sheet for the Central, Southern and Eastern plantations, we see that survival and growth of the Southern cluster provenances was only fair to good; but they grew well above the plantation means in Oklahoma and in Missouri. Then lets concentrate again on the NC Nebraska and CRM clusters. Here we see the growth of the NC Nebraska cluster ranged from 114 to 170 percent of the plantation means. In contrast, growth of the CRM cluster ranged from only 76 to 92 percent.

The bottom line is that these 3 provenances in NC Nebraska and south-central South Dakota performed exceptionally and consistently well in practically all plantations. This is all the more remarkable considering the range in climatic conditions and soils that exists between Alberta or Saskatchewan and Oklahoma or Missouri. In contrast, the CRM cluster performed consistently poor in all plantations. Only in Alberta did these provenances show anywhere near the plantations mean.

There's more... we should also note the Northern High Plains cluster, because six provenances in that area performed consistently well. The best were from Roundup and from Ashland, Montana, which showed higher than 110 percent of the plantation means in 15 of 17, over 80% of the plantations. Also in Montana, provenances near Helena, Jordan and Colstrip showed well above average in 10 of 17, 60% of the plantations. In Nebraska, the Merriman provenance, just up the Niobrara River 60 miles from the best cluster, showed superior growth in 8 of 16, 50% of the plantations.

Since all of you will be interested in seeing how the individual seed provenances performed in all plantations, I plan to include that data in a forthcoming publication. For this presentation, however, the cluster means table will suffice, since these are the statistically significant data.

So to the end this dissertation, I simply want to say that our first efforts to provide new knowledge of ponderosa pine seed provenances that will enable better use of that species in planting programs, have paid off. From here we go to the 15 and 20 year performance, to determine whether or not these population delineations will hold up. The Lincoln unit of the Rocky Mountain Station is now in process of analyzing the 15 year data.

And the next step in the use of these research data will come in the selection of trees in the best cluster areas for open-pollinated progeny tests, which my colleague Dick Jeffers will describe to you in the next presentation.

Ponderosa Pine Open-Pollinated Progeny Tests for the Great Plains

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Early results of the Great Plains test of ponderosa pine from the eastern portion of the species range indicated that trees from near Valentine in north-central Nebraska performed extremely well and were the best or among the best provenances at nearly all locations. Consequently, this provenance has been recommended for use in Great Plains planting programs, and demand for seed from this source has been so great that current needs cannot be met.

Based upon 10-year results of this test which includes trees form 80 geographic origins planted at 17 locations in two Canadian provinces, five Great Plains states, Michigan, Missouri, and Pennsylvania, Read (1983) has recommended that seed from four additional origins - two in Montana, one in south-central South Dakota, and a second source from north-central Nebraska be used in Great Plains planting programs.

As a follow-up to the provenance study, a test of open-pollinated progenies from superior phenotypes selected in the five geographic areas recommended by Read has been initiated in Saskatchewan, Montana, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Oklahoma, and Texas. Parent trees will be selected on the basis of traits desirable for use in Great Plains planting programs. Seed will be extracted, cleaned, and handled by the Rocky Mountain Forest and Range Experiment Station, Lincoln, Nebraska. Seedlings for the progeny tests will be grown in containers by Saskatchewan, North Dakota Forest Service, Kansas State and Extension Forestry, Colorado Forest Service, and Texas Forest Service.

All cooperators will test progenies from selections made at Rosebud, South Dakota, and from the Ainsworth-Valentine, Nebraska area. In addition to these progeny, Saskatchewan and the States of Montana, North Dakota, South Dakota, Kansas, Colorado, and Oklahoma will also test progenies from selections made at Ashland and Roundup, Montana. Oklahoma and Texas will also test progenies from selections made in eastern New Mexico sources that performed well in the Oklahoma provenance test. Progeny from a few other selected sources may be included in individual state tests. Most plantings will include 20 or more progeny from about 100 parent selections from a minimum of five selected sources.

A randomized, complete block, planting design will be used in each planting with a restriction that seedlings from the same parent tree cannot occur closer than two planting spots apart. This type of design will permit thinning of the planting when the tree crowns begin to compete with each other, without seriously affecting final spacing. Based upon planting evaluations, thinnings will be made to retain individuals with the best growth, form, and branching habits. The greatest number of individuals retained will undoubtedly be from the best performing families. Trees form poorer-than-average families will also be retained if they meet

the same evaluation criteria used to select the best individuals from the best families. The actual number of trees to be removed in thinnings will depend upon performance of all individuals and families in each planting. At the time of thinning the maximum number of families that may be entirely removed probably will not exceed one-third of the total number of families. Retention of at least two-thirds of the families will ensure maintenance of a broad genetic base.

When an adequate number of female and male strobili area available in these progeny tests, controlled pollinations will be made to provide a series of full-sib families to be used in second generation seed orchards. Controlled pollinations will be made among the best individuals according to a crossing scheme designed to provide sets of full-sib families that can be evaluated as each set of pollinations is completed. Second generation seed orchards can then be established with seedlings or rooted cuttings from the full-sib families.

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Woody Habitats in Southwestern North Dakota

Michelle M. Girard[1]
Harold Goetz[1]
Ardell J. Bjugstad[2]

INTRODUCTION

Scattered throughout the prairies of western North Dakota are small pockets and draws of native woodlands. Their establishment is restricted to areas of increased moisture, hence their distribution is quite limited. Some of the woody species reach the outer extensions of their range here as the climate becomes unfavorable for their establishment, growth and regeneration. Low precipitation, cold temperatures and a short growing season are all contributing factors.

These woody draws represent less than 1% of the vegetation of North Dakota (Bjugstad 1978; Jakes and Smith 1982). While their extent is extremely limited, their importance and value is far reaching. These unique communities are important for wildlife and livestock habitats, soil stabilization, watershed maintenance, firewood, aesthetics and species diversity. An estimate of their value has been placed at $10 million annually in the Northern Great Plains. This is primarily attributed to the production and the subsequent hunting of wildlife in these areas (Bjugstad 1983).

Research began in 1981 and will continue through 1983 to establish a habitat type description and classification system for the woodland vegetation of the Northern High Plains in western North Dakota. A habitat type is defined as a collective area composed of soil, climate and topographical variables which are capable of supporting a certain, relatively homogeneous plant community. The classification scheme is based on species composition, species canopy coverage, production, soil type and topography of relatively undisturbed woodland communities considered to be in excellent condition.

The study area includes the counties of Billings, Bowman, Dunn, Golden Valley, McKenzie, Slope and Stark in western North Dakota. It lies in a region classified as the Missouri Slope of the Northern High Plains and is more commonly referred to as the Little Missouri Grasslands. Most of the study area is concentrated in the unglaciated regions of the Slope surrounding the Little Missouri River. The northern reaches of the study area do include the glaciated regions south of the Missouri River.

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Vegetation of the study area is a mosaic of several different plant communities (Garrison et al. 1977). The predominant vegetation is broadly classified as mixed grass prairie, with shrubby stands and woody draws interspersed within it. These communities provide a stark contrast to the barren badland buttes which are also characteristic of the area. The rolling topography and steep buttes form some of the habitats which are favorable for woody species. Communities are found restricted to areas of run-in, draws or coulees, springs, streams and intermittent streams, concavities in the landscape, floodplains and north-facing slopes.

METHODS

Stands were subjectively selected to represent relatively undisturbed communities. Stands may have received use by wildlife and light grazing by domestic livestock, but had all the characteristics of a perpetuating stand, e.g., several layers, regeneration and lack of deterioriation.

A 20 x 20 m macroplot was established within each stand where the vegetation was most homogeneously distributed (Mueggler and Stewart 1980). Two transect lines were placed 5 m in from each of the 2 outside plot boundaries which parallel the length of the community. Vegetation within the stand was then divided into 4 strata: herbaceous, shrub, sapling and tree. Strata were defined on the basis of height and/or diameter at breast height (DBH), not growth form. Therefore, a species normally considered a shrub, red-osier dogwood (Cornus stolonifera) for example, may be sampled in the herbaceous, shrub or sapling layer. Definitions and sampling methods were as follows:

Herbaceous. Vegetation less than 1 m tall was sampled within a 20x50 cm microplant (Daubenmire 1959). All species and their percent canopy coverage over the microplot were recorded by classes (Table 1). A total of 40 frames, 20 spaced evenly along each transect were sampled.

Shrub. Woody vegetation more than 30 cm but less than 2 m in height were measured in 6 milacre plots, 3 evenly spaced along each transect. Species, height, crown vigor, number of stems and degree of browse were recorded for each shrub rooted within each milacre plot.

Sapling. Saplings, were defined as woody vegetation more than 2 m tall but with DBH of less than 10 cm. All saplings within the macroplot were sampled. Height, crown, DBH, vigor and origin were recorded.

Tree. Trees have a DBH of more than 10 cm. Sampling is identical to that for saplings. Four or five of the larger trees were cored in order to determine an average age of the stand.

Table 1. Percentage classes used to estimate canopy coverage of herbaceous species in a 20 x 50 cm microplot (Daubenmire 1959).

Class	Percentage
1	in macroplot
2	0 - 1 %
3	1 - 5
4	5 - 25
5	25 - 50
6	50 - 75
7	75 - 95
8	95 - 100%

RESULTS AND DISCUSSION

Coupled with the inherent diversity of the plant species were a number of environmental factors which exerted a tremendous influence on community composition. Some of these were slope, aspect, topography, areal distribution, soils, disturbances, moisture and the time of the year sampled. Attempts to "fine-tune" the habitat type classification by correlating the dominant species of each strata between stands have been unsuccessful up to this point. Shrub and sapling strata are quite similar in most of the stands, regardless of the dominant tree species. The herbaceous layer was so high in species richness and diversity that no correlations between stands, even those with the same dominant tree species have yet been established. Analysis of the data at this time only allows division of the communities based on the dominant tree species which are: Paper birch (Betula papyrifera), green ash (Fraxinus pennsylvanica), Rocky Mountain juniper (Juniperus scopulorum), ponderosa pine (Pinus ponderosa), cottonwood (Populus deltoides), trembling aspen (Populus tremuloides) and bur oak (Quercus macrocarpa). Communities will therefore be defined by dominant tree species.

Table 2 shows the mean number of species encountered in each of the community vegetation layers. The tree canopy of most of the stands was usually dominated by one species, with individuals of other species occasionally found intermingled. The sampling layer showed a range of an average of 2 species in the juniper and pine stands, up to 7 species in bur oak. The shrub layers also illustrate a wide variance in the number of species, an average of 4 species was found in the ponderosa pine and up to a mean of 10 in the trembling aspen. The herbaceous layer was the most diverse, with the average number of species varying from 24 to 32. Ponderosa pine demonstrated the lowest species richness values, and trembling aspen showed the most diversity.

Specific communities were often found in association with certain topographic and/or edaphic conditions. These communities--habitat types--often have several understory species in common. A brief description of these habitat types and their characteristics will now be outlined.

Table 2. The mean number of species encountered in each strata of the communities.

Dominant tree	Tree	Sapling	Shrub	Herbaceous
cottonwood	2	3	6	26
bur oak	3	7	7	24
green ash	2	4	8	32
paper birch	2	5	9	33
ponderosa pine	2	2	4	24
Rocky Mountain juniper	2	2	5	28
trembling aspen	2	6	10	32

GREEN ASH HABITAT TYPE

Green ash dominated communities were the most frequent and most widely distributed of all the woodland habitat types in western North Dakota. It was commonly found in upland coulees and draws, broad valleys and on floodplains. The canopy coverage in all layers was usually quite dense. The tree canopy was composed primarily of green ash, sometimes associated with American elm (Ulmus americana) and less frequently with Rocky Mountain juniper. The sampling strata was most often dominated by chokecherry (Prunus virginiana). Green ash was also a significant component of the sampling layer of communities which were in excellent condition, ensuring its replacement in the treen canopy. Chokecherry and snowberry (Symphoricarops occidentalis) dominated the shrub component. The total number of herbaceous species in green ash communities, 76, was the largest encountered. This high diversity caused low individual species cover values and thus makes it difficult to specify a dominant species. Kentucky blue grass (Poa pratensis), burdock (Arctium minus), black snakerood (Sanicula marylandica) and northern bedstraw (Galium boreale) are commonly encountered.

ROCKY MOUNTAIN JUNIPER HABITAT TYPE

Rocky Mountain juniper forms one of the most rugged communities, restricted to steep, north facing slopes. However, scattered individuals were found on a number of diverse locations, rocky outcrops, butte tops, draws and floodplains. Junipers dominate the tree, sapling and shrub layers of the communities guaranteeing its regeneration and continued dominance. Little ricegrass (Oryzopsis micrantha) and moss (Thuidium abietinum) are typical herbaceous species. The distribution of little ricegrass was scattered across the communities, but its common for moss to form a continuous thick "carpet" on the substrate.

COTTONWOOD HABITAT TYPE

Cottonwoods were found distributed as scattered individuals in moist ravines and ditches, as narrow, stringer types along streambanks, and reach their best expression of community dominance along the floodplains of the Little Missouri River. Cottonwood is a seral or transitional species. There is no regeneration of the species under the mature tree canopy, but younger communities can be found along the riverbanks as the Little Missouri River meanders, depositing sediments favorable for its germination. The tree canopy and individual spacing was naturally much more open than the other tree types. Composition was cottonwood in association with juniper and green ash, the latter 2 species were also prevalent in the sapling layer. Snowberry density was high in both the shrub and herb strata. Other common herbaceous species were Kentucky blue grass and poison ivy (Rhus radicans).

BUR OAK HABITAT TYPE

Distribution of bur oak was quite sporadic, it was limited to the Killdeer Mountains, Lone Butte and Blue Buttes regions. It also is often considered a seral species, however, evidence of reproduction can be found. The tree canopy is dominated by bur oak along with a significant proportion of green ash. Diversity of the sapling and shrub layers is quite high dominated by beaked hazelnut (Corylus cornuta) and chokecherry. The diversity of the herbaceous zone is relatively low, dominated by sedges (Carex species).

TREMBLING ASPEN HABITAT TYPE

Trembling aspen was found in numerous, small stands widely distributed throughout western North Dakota, and the frequency of its occurrence increased in the northern portions of the area. Communities were found in concavities in the topography, on north facing slopes and often at the crown of green ash draws. Mature aspen trees are usually closely spaced and green ash was occasionally intermingled in the canopy. Equal amounts of trembling aspen and green ash occurred in the sapling division which indicates that the trembling aspen, often considered a seral species, is being replaced by green ash. Chokecherry and snowberry dominated both the shrub and herb layers where the canopy coverage was quite dense. Other species which were often encountered in association with trembling aspen were poison ivy and sarsparilla (Aralia nudicaulis).

PAPER BIRCH HABITAT TYPE

Paper birch dominance is restricted to areas of very high moisture, often in association with springs and north facing slopes. The high moisture conditions also favor a lush understory. Association of paper birch and trembling aspen in the tree and sapling overstory is common. The shrub layer is similar to bur oak, beaked hazelnut and chokecherry dominate. Snowberry and false melic (Schizachne purpurascens) compose a significant portion of the herbaceous layer.

PONDEROSA PINE HABITAT TYPE

Ponderosa pine communities are somewhat of an anomoly. Their distribution is restricted to approximately 4300 acres north of Amidon, with small outliers found in Bowman county and east of Medora, North Dakota. These represent the most northeasterly extension of the species. The pines are fairly homogenously distributed within the stands, which are interspersed with grasslands. Juniper is frequently encountered in the tree canopy also. This was the only type where skunkbush sumac (Rhus trilobata) dominated the shrub layer. However, it was similar to many of the other types of the herbaceous layer, which was dominated by snowberry and poison ivy.

CONCLUSION

Woodlands of western North Dakota form unique, diverse and productive communities important for wildlife and livestock habitats, soil stabilization, watershed maintenance and genetic diversity. The study was concerned with relatively undisturbed stands in excellent condition. A characteristic common to stands in excellent condition was reproduction of tree species and lack of disturbances such as grazing, browsing and trampling. Stands in lower condition classes lacked reproduction of tree species which will result in a decline of the quality and quantity of woodlands. Sampling will continue through the 1983 field season in order to refine the habitat type descriptions and community classifications. This information will then be used to formulate comprehensive management plans and to construct vegetation maps.

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Streambank Revegetation on Lower Yellowstone and Missouri Rivers

By: Leon D. Logan
July 1983

Introduction and History

The Forest Service, State Foresters and the Corp of Engineers cooperated on vegetative management around Corps Reservoir prior to Public Law 93-251, called the "Streambank Erosion Control Evaluation and Demonstration Act of 1974".

Under the "Streambank Erosion Control Act" the Forest Service, in cooperation with North Dakota Forest Service, North Dakota State University and the Corps of Engineers, Omaha District, began the streambank revegetation on the Missouri River below Garrison Dam and on the Yellowstone River in North Dakota.

This was actuated by an agreement among the three institutions that produced two documents:

1. "Vegetation and Mechanical Systems for Streambank Erosion Control".[1/]
2. Site specific plans for sites to be treated.[2/]

Projects

In 1976-77, we gained planning and field experience in using vegetation to control streambank erosion on the Cheyenne River, near Lisbon, North Dakota.[3/] This project was under Sec. 216 of the 1950 Flood Control Act and was done in cooperation with North Dakota Forest Service and North Dakota State University.

Slides of Cheyenne River project

Discussion

With this experience, we approached the Missouri and Yellowstone Projects.

Slides

1. Site delineations for species selection
2. Site preparation
3. Plant materials
4. Planting
5. Post Planting

Project Conditions and Concerns

1. Site situation--dry, intermediate, wet
2. Species adaptability
3. Plant materials

Project Conditions and Concerns, continued

4. Plant materials handling[2]
5. Planting
6. Plantation followup; i.e., irrigation, competition control, fertilization, etc.

Results

75% to 95% survival and growth with irrigation the first growing season depending on species.

Generally, at this time juncture, the vegetation projects are progressing very well and doing the job intended, protecting the site.

References

1. "Guideline for Streambank Erosion Control Along the Banks of the Missouri River from Garrison Dam Downstream to Bismarck, North Dakota, 1979, by an interdisciplinary team led by Leon D. Logan, USDA, Forest Service, State and Private Forestry, Missoula, Montana.

2. Site specific plans on file at Northern Region, USDA, Forest Service, Missoula, Montana.

3. Cheyene River Project on file at Northern Region, USDA, Forest Service, Missoula, Montana.

Conifer Seedling Establishment and Water Relations on Strip-Mined Lands in Eastern Montana

By: Nan C. Vance
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Abstract

In 1982 three-year-old (3-0) bareroot and one-year-old (1-0) containerized ponderosa pine seedlings were planted on regraded mine soil at Colstrip, Montana. Shade cards were applied to determine if shading increased survival or reduced moisture stress. At the end of the growing season 97.2% of the 1-0 seedlings and 92.5% of the 3-0 seedlings had survived. Shade card treatment effects on survival or moisture stress were not detected. Seedling moisture stress peaked in August, the hottest month, and declined to near pre-summer levels by the end of October.

Introduction

In 1979 several studies related to mine spoil vegetation at Colstrip, Montana, were begun by the University of Montana, School of Forestry. One major concern was to reestablish ponderosa pine and Rocky Mountain juniper on strip mined and regraded land that formerly supported these species. Nancy Richardson (M.S. thesis unpubl.) in describing regeneration patterns at Colstrip suggested that seedling survival was dependent upon the seedling's ability to withstand the stress of high radiation loads and sporadic rainfall that commonly occur in eastern Montana in the late summer months. Dr. Steven W. Running began directing studies of ponderosa pine stress physiology in 1980. He found that characterizing stress development in pine seedlings planted in the area was confounded by the poor quality and off site origins of the seedlings. Beginning in 1982, better seedlings with seed origins at or near Colstrip were available which enabled long term monitoring of stress development. Permanent seedling study plots were established April 1982 for this and subsequent studies.

The objectives of the 1982 study were to compare the survival of larger older bareroot ponderosa pine seedlings with smaller, younger containerized seedlings planted at the same site, and to compare the effects of shade cards on seedling survival, morphology and stress development. Another objective was to monitor moisture stress during the growing season as in previous years to determine the relationship of moisture stress to survival and to assess the relationship of local weather patterns to stress development.

Methods

Establishing the Study

On April 30, 1982, 600 three-year-old (3-0) bareroot ponderosa pine seedlings grown at the North Dakota State Nursery, Towner, North Dakota, (seed origin Carter County, Montana) were planted on a gentle north slope of regraded mine soil in Area B at Colstrip, Montana. The seedlings were lifted, pacted in sphagnum moss and shipped April 23 by mail in reinforced paper containers. They arrived cool and moist and were kept in that condition as much as possible up to planting. Planting was aided by a power auger which drilled holes approximately 6 inches in diameter and 12 inches deep. Shortly after planting seedlings were moistened with approximately one pint of water each. Watering each seedling at planting is not a usual operational procedure but was done to help alleviate the stressful conditions of planting and drying of upturned soil. Xylem pressure potential readings taken with a pressure chamber (Scholander et al. 1965, Ritchie and Hinckley 1975) indicated low moisture stress in seedlings prior to planting.

In addition 105 containerized seedlings (1-0) grown in Plains, Montana, at the Champion greenhouse (seed source, Colstrip) were planted the following day by the above stated methods. Following planting, shade cards were installed on the south-southwest (uphill) side of the seedlings on alternative rows.

Measurements

Monthly measurements were taken beginning the first week in June and ending the third week in October. Pre-dawn measurements of xylem pressure potential were taken with the pressure chamber of randomly sampled seedlings at the 3-0 and 1-0 plots. The measure of xylem pressure potential just before dawn when the water status of the seedling is in equilibrium with that of the soil indicates at that time the water available to the plant (Hinckley et al. 1978). Measurements taken over the course of the season provided a means for tracking any progressive soil moisture depletion and subsequent plant stress development.

Monthly data were also taken at both plots tallying growth and survival of each seedling. A rating system was used where the following numbers were assigned to rate seedlings: (1) no visible damage, good color, leader elongation and needle length (at least 3 cm by September); (2) no damage, less leader elongation and leader length; (3) no visible needle development or leader elongation; (4) significant damage or brown needles (greater than 25 percent); (5) dead (greater than 90 percent brown needles).

Results and Discussion

Moisture stress development based on pre-dawn xylem pressure potential taken monthly are summarized in Figure 1. The data points represent means of 6 to 8 seedlings measured from each plot. Stress for the 1-0 and 3-0 seedlings gradually increased during the summer to August and declined in September and October. In 1982 mean monthly high temperatures reached a similar peak in August. Table 1 of average precipitation for each month from June

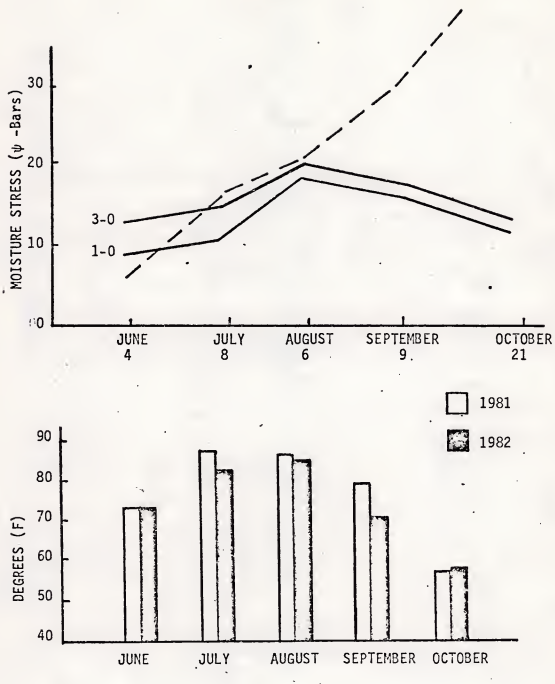

Figure 1. Seasonal moisture stress development of 1-0 and 3-0 ponderosa pine seedlings planted April 1982 at Colstrip, Montana in regraded mine soil (dashed line is stress development of 1981 planted seedlings); also mean monthly high temperatures at Colstrip in 1981 and 1982.

Table 1. Mean monthly precipitation 1980-1982 (inches)

Month	1980	1981	1982
May	1.43	6.22	1.63
June	1.81	3.69	1.90
July	0.34	1.49	1.04
August	1.63	0.83	1.13
September	0.54	0.68	1.59
October	1.91	1.78	1.10

to October shows higher than normal total precipitation for September. Figure 1 also shows moisture stress development during 1981 of seedlings planted on a nearby site. During the course of the season moisture stress increased. By the end of October no seedlings had survived. Average high temperatures July through September were higher in 1981 than in 1982 (Figure 1) and mean monthly precipitation in August and September was lower (Table 1). In 1982 precipitation during the growing season was fairly evenly distributed and means did not vary appreciably from month to month. By contrast, there was one droughty period in 1981 where calculations from NOAA (1981) climatological records indicated less than .75 inches of precipitation between August 5 and September 26. This was the period when moisture stress increased to levels beyond recovery and subsequent mortality occurred. The 1981 weather patterns made a key contribution to the poorer survival of the 1981 seedlings already ill suited to the site.

The 1982 seedling survival tallies are summarized in Table 2. The ratings 1 and 2, 3 and 4, and 5 and M were combined because these three categories best represent the overall status of the plots. The specific meaning of the numbered ratings or categories is explained in the Methods Section. Live seedlings dug up were not included in the survival percentages, since they were rated M in subsequent tallies. Table 2 shows the survival percentages at the end of the 1982 growing season: 97.2% on the 1-0 plot and 92.5% on the 3-0 plot. The 3-0 seedlings, although they appeared to be establishing better than seedlings in previous years, did not rate as high in the 1-2 category of survival and growth potential as the 1-0 seedlings. Because of their size, they had some root damage and lower root-shoot ratio and suffered greater planting shock than the containerized 1-0 seedlings.

A chi square test of independence on mortality and shade in the 3-0 plot indicated that mortality probably occurred independently of shading: $x^2 = .39$ (the 1-0 plot had no visible mortality so an analysis was not done). The data were broken down by shade and no shade treatments only for June and July because by July seeded grasses had overtopped the shade cards confounding the shade card effects. Although moisture stress data and the survival and growth data did not reveal any effects of the shade treatment because of shading by the emerging grasses and forbs, it cannot be concluded that shading does not enhance seedling survival.

Other observations: Three rows of 1-0 seedlings and individual seedlings on the 3-0 plot were silted over to a varying degree. One seedling was buried totally except for the tops of 4 needles. Growth, though inhibited by the silt, continued except in extreme cases. Seedlings were dug out as much as possible. Some seedlings appeared chlorotic which seemed to occur independently of the size of the seedling or shade treatment. Deer were observed at the site but there was little evidence of clipping.

Several seedlings were dug up to observe root egress. As of October there was no evidence of lateral roots penetrating the auger drilled holes. The sides of the holes had been compressed by the auger at time of planting and remained that way through the summer based on observations of dug up seedlings. Soil at the site varied but texture was a silty clay. By October there were cracks and fissures in some of the walls through which roots might penetrate. Seedlings dug up in spring 1983 showed vigorous root growth in the 1-0 seedlings, less root extention in the 3-0 seedlings and little evidence of soil compression in the sides of the auger holes.

Table 2. Summarization of seedling survival tallies

1-0 Plot

	June		July		October	
Rating	Shade	No Shade	Shade	No Shade	Total	Percent
1-2	54	37	53	38	101	96.2
3-4	6	6	6	6	1	1.0
5-M	0	2	0	2	3	2.8
TOTAL	60	45	60	45	105	100.0

Total survival: 97.2%

3-0 Plot

	June		July		October	
Rating	Shade	No Shade	Shade	No Shade	Total	Percent
1-2	273	274	242	237	497	82.8
3-4	21	20	49	55	58	9.7
5-M	6	6	9	8	45	7.5
TOTAL	300	300	300	300	600	100.0

Total survival: 92.5%

Conclusion

Seedling survival was very high in 1982 and provided for continued studies in 1983. Although shading effects were not measurable, shading should not be ruled out as a means of increasing survival on an exposed site. Seedling moisture stress increased with the higher temperatures and reduced precipitation of late summer but showed recovery by fall. This recovery was reflected on the high seedling survival, which did not occur with the 1981 seedlings.

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First Year Results of Fertilization in Newly Established Drip-Irrigated Windbreaks

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Windbreaks and shelterbelts play important roles throughout the Great plains, but their usefulness varies from the north to the south. In the northern Great Plains, WB/SB are planted to protect livestock from winter winds and to reduce farmstead energy costs. In addition, a major function of northern WB/SB is to provide for a more even distribution of snowfall across the fields, allowing the soil to accumulate moisture prior the growing season. In the southern Great Plains, a major purpose of WB/SB is to protect fields and crops from the influence of hot desiccating summer winds.

The use of drip irrigation is becoming a widely accepted method of overcoming the environmental limitations for the establishment of windbreaks and shelterbelts in the southern region. But prior to the initiation of this study, no research had been published to document the success of the practice in the southern Great Plains, nor had information on the effects of fertilizing WB/SB been documented.

The rationale for conducting this study and the methods utilized were reported at the 1982 GPAC-Forestry Committee Meeting in Dodge City, Kansas, and were published in the proceedings. In review, the overall goals of the project were to determine if the effect of supplemental fertilization would: (1) decrease the overall amount of water and time needed for tree and shrub establishment in conjunction with a drip irrigation system, and (2) shorten the interval between initial establishment and the formation of an actively functioning WB/SB. Three types of fertilizer were studied. Two had slow-release formulations (Agriform tablet and sulfur-coated urea) while the third was a prepared readily soluble mixture (ammonium nitrate plus 10-20-10). The percent nitrogen was standardized among the three fertilizer types, while the percentage of phosphorous and potassium varied. Fertilizer was applied at two (high vs. low) or three rates (high, medium, low) depending on the availability of seedlings, plus an unfertilized control. Four different sites were selected representing four soil types; all had installed drip irrigation systems and planted similar species. The age of the plantings varied from newly established to two years old.

Results and Discussion

Plant response to the fertilizer treatments was analyzed separately for each of the four experimental sites because of differences in location, soil texture (which ranged from a fine sand to silt loam), and management practices.

Professional Paper P-1442 of the Ag. Expt. Station, Oklahoma State Univ.

Site 1

In general, there were few statistically significant differences (p less than or equal to 0.05) in height or diameter growth due to the fertilizer treatments, although there were some marked detrimental effects. For example, 16 of the 24 Austrian pine (Pinus nigra Arnold) that died had been treated with the readily soluble mixture (RSM). Because of this degree of mortality, the overall survival rate for this species was 63%. The survival rates for the Russian-olive (Elaeagnus augustifolia L.) and the juniper (Juniperus virginiana L.) were 93% and 87% respectively. The average height growth for all combined treatments and rates for the Russian-olive (second growing season) was 165%, for the juniper it was 112%, and for the pine it was 101%. In addition, the determinant growth habit of the pine allowed third year height growth to be estimated as a 100% increase. However, these responses were not significantly different from the controls due to the large variance of the population.

Site 2

The survival rate for the bare-rooted arborvitae (Thuja orientalis L.) was 82%, while survival for the containerized Austrian pine was 93%. There were no significant differences found for height and diameter growth due to the fertilizer treatments, but there were some observed differences. The average percent increase in height of the arborvitae and Austrian pine was low for the first growing season (40% and 24%, respectively), reflecting the extremely harsh nature of this site. The average diameter of the Austrian pine over all treatments and rates more than doubled in size during the first growing season (159% increase), perhaps indicating the preferential allocation of photosynthate towards development of lateral conductive tissue in this species. Such development would be of obvious adaptive advantage for survival under stressed conditions. The arborvitae were damaged by grasshoppers during the summer of 1982, but by the fall they appeared to recover. The enhanced nutrient status of the plants may have contributed to this recovery. In addition, the height growth of the arborvitae was significantly greater than the control trees. The third species, Russian-olive, was planted on an adjacent area. Because of lack of weed control, survival averaged only 60%, and height growth for all treatments increased only 22%.

Site 3

The plants were the oldest at this site, having finished their second growing season prior to the fertilizer application. The survival rate for both the Russian-olive and the juniper was 100%. However, survival of the Austrian pine was 88% due to browsing of the buds by sheep. Six of the ten pines that died had been treated with RSM fertilizer, although browsing confounds the exact cause of death.

There were few significant responses to the fertilizer treatments by the Russian-olive and the juniper. Again, the percent increase in height growth for the pines treated at the high rate of the RSM was much lower than for the unfertilized controls, but diameter growth from all fertilizer treatments was larger than the controls. Lack of judicious weed control undoubtedly limited the treatment responses.

Site 4

There were no significant responses to the fertilizer treatments during the second growing season (first after fertilization) although all of the species grew exceptionally well. The site was kept free of weeds throughout the year by the landowner by disking and hoeing. The survival rates on this site were 98% for the Russian-olive and juniper, and 80% for the Austrian pine (five of the 10 dead trees were treated with RSM fertilizer). The average percent increase in height for the Russian-olive, juniper, and Austrian pine was 24, 110, and 94%, respectively. Third season height growth for the pine was estimated to be 152% greater than the previous year.

Conclusions and Recommendations

Prior to this study, very little information had been reported to document the survival rates and growth responses of windbreak plantings when irrigated by means of a drip watering system. In addition, no assessment had been made of the effects of supplemental fertilization in combination with a drip system on newly planted WB/SB.

The following conclusions can be made form this study:

1. Survival rates of WB/SB plantings in Western Oklahoma on four soil types averaged 80-100% using drip irrigation in combination with supplemental fertilization.

2. The response to fertilization varied depending on the treated species. The Russian-olive (a nitrogen-fixing species) was the least affected, while the Austrian pine was more sensitive to fertilizer application. Care should be taken in applying high rates of readily soluble fertilizer on clay soils.

3. In general, the statistical analysis indicated few significant effects due to the fertilizer treatments, as compared to the controls. However, the wide variation in growth response indicated that a better experimental design is needed to evaluate the treatment responses.

4. A one year period after fertilization, particularly for one and two year old plantings, may not be enough time to fully evaluate the effects of the fertilizer treatments.

5. Weed control is just as important to the initial growth and development of WB/SB plantings as the application of fertilizer. Enhanced growth may result from a combination of these cultural practices.

6. A more controlled research area, such as the Southern Plains Range Research Station in Woodward, Oklahoma would facilitate experimental procedure and limit the variation in cultural management as practiced by multiple landowners.

Future research is needed to not only quantify the effects of fertilization on WB/SB plantings, but also to examine basic factors such as the determination of the optimum rate, amount, and timing of irrigation by soil types and degree of environmental stress; the effects of cultural practices (irrigation, fertilization, control of weeds, animals, insects, disease) on plant physiological processes, including root development; the interaction of planting stock (bare-root vs. containerized) with cultural practice; and the degree of natural species variation in growth and development when grown in conjunction with a drip system. This research needs to be conducted over a period of time sufficient to monitor these various parameters at all stages of windbreak development.

Nebraska Living Snowfence Program[1/]

By: Doak Nickerson[2/]

Introduction

The single, most dominant influence on the Great Plains environment is diverse weather. This is due to the geographical location of the Great Plains east of the Rocky Mountains. Powerful meteorological influences like Pacific fronts, moist Gulf air, and frigid Artic air masses can create extreme weather conditions on the Plains.

Recognizing all the different forms of weather that man has to tolerate, the presence of wind is by far the strongest adversary. Webster's Dictionary defines wind as a natural movement of air at any velocity. Due to the relative openness of the Plains, most of the winds move at great velocity!

Planting of trees and shrubs in a windbreak has long been recognized as the most effective way to combat wind. A windbreak modifies the Plains environment, holds the soil, and increase aesthetics. Considering all the different types of soil conservation practices recognized today, planting a windbreak remains the hallmark practice. No other conservation practice provides such numerous and enduring benefits.

This paper is going to discuss an obvious benefit reaped form a windbreak, which is blowing snow management. More specifically, the planting of a windbreak as a living snowfence along county roads in Nebraska will be covered. The presentation will reflect primarily data and information from landowners, local government officials, as well as my own observations. The cost comparison data herein is very basic and straight forward. Its expressed purpose is to emphasize the economic attractiveness of a living snowfence, as compared to conventional slatted snowfence.

The majority of the information for this paper was derived from Valley County, located in central Nebraska.

State of the Art

The concept of planting a windbreak to prevent road closure is not new. However, actually planting a windbreak for the specific purpose of functioning as a living snowfence is not so common.

1/ Paper presented at 35th Annual Meeting of the Great Plains Agricultural Council Forestry Committee. Billings, Montana, July 11-14, 1983.

2/ Doak Nickerson, District Forester, Nebraska Forest Service, (Department of Forestry, Fisheries, and Wildlife), University of Nebraska Panhandle Station, Scottsbluff, Nebraska, 69361.

Very little study or research on a living snowfence has been done in the past. Government and university publications contained minimal information. Of the information that was found, the following statement hits on what has probably been overlooked. According to Stoeckeler (1949), Thomas T. Wilson of the Manitoba Department of Public Works found the cost of maintaining a simple slatted snowfence to be twice that of a single row of trees and shrubs.

Volumes of research have been done on snow storage of a slatted snowfence. However, it should be recognized that the main thrust of these studies were to determine the most effective design, construction, and spacing of a slatted snowfence. To a certain extent, these research results can be applied to a living snowfence.

Purpose

The primary purpose of the Nebraska Living Snowfence Program is to replace the use of a conventional slatted snowfence with a windbreak. This applies specifically to areas along county road right-of-ways.

The use of a slatted snowfence to prevent road closure has been widely used in the Great Plains. However, as this paper will show, construction and maintenance of a slatted snowfence is extremely expensive. A living snowfence is far more cost effective.

The secondary benefit of the Program is to establish, maintain, and provide habitat for wildlife. Last, and of equal importance, the Program brings together county, state, local, and federal governments, along with private landowners. The end result is a cooperative effort to bring about an economical and aesthetically acceptable solution to common concerns.

How the Program Works

As stated earlier, the Living Snowfence Program brings together different governments and individual landowners in a cooperative effort. Each of these entities has a specific responsibility and input into the Program. Thus, establishment of a direct line of communication as well as a viable working relationship among interests is the lifeblood that got the Program off the ground.

In order for the Living Snowfence Program to be instigated, there has to be an incentive for the private landowner to give up a strip of land to be planted to trees. This obstacle was overcome by enrolling the landowner in the Private Lands Habitat Program. The Habitat Program pays the landowner a certain dollar amount per acre, per year for the living snowfence area under contract.

The Habitat Program was born and developed by the State of Nebraska Game and Parks Commission. It is a cost sharing program, whereby new wildlife habitat is created and enhanced on private lands. The Habitat Program is a joint venture between the Game Commission and an individual Natural Resource District (i.e. NRD), with administration the responsibility of the NRD. Funding is authorized on a 75%-25% arrangement from the Game Commission and NRD, respectively. Game Commission funds are derived from the sale of hunting/fishing licenses and habitat stamps. NRD funds are provided through the general level of the NRD.

The Habitat Program contains several different practices for promoting habitat, each practice paying a different lease rate. The Lower Loup NRD founder of the Living Snowfence Program, has the Snowfence Program under a separate practice in the Habitat Program.

In order to better describe how the Living Snowfence Program works, I feel it best to describe each entity and their respective responsibilities.

Private Landowner

Any tax paying landowner or renter that manages land adjacent to problem areas where road closure is common. Responsibilities include:

1. Make application for inclusion of selected area in the NRD's Habitat Program.
2. Provide labor/equipment to do advance site preparation.
3. Maintain fence around planting for duration of contract.
4. Receive annual payments on lease contract from the Habitat Program.

County Government

Any individual county, represented by an appointed county road superintendent under the guidance of an elected county Board of Commissioners. Responsibilities include:

1. Determine and select problem areas where road closure is common.
2. Contact private landowner and work specific details.
3. Pay for tree planting service and replanting.
4. Pay for weed control in the row.
5. Pay for planting of cover crop and grass between rows.
6. Pay for labor/equipment needed for fence construction.

State Government

This is the State of Nebraska Game and Parks Commission, the primary sponsor and innovator of the Private Lands Habitat Program. Responsibilities include:

1. Provide all improvement materials, including fence, trees, replants for two years, seed for cover crop between rows, and grass seed after establishment.
2. Provide 75% cost share funding for annual lease payment to landowners.

Local Government

This is a local, governmental subdivision known as the NRD. The NRD concept is unique to Nebraska, as no other state in the United States of America has a local governing organization comparable to it. There are 24 NRD's across Nebraska, each having boundaries delineated by major watersheds. The NRD system was implemented in 1972 under legislation adopted in 1969 by the Nebraska Unicameral. NRD's replace agencies of more

specific concern, such as soil and water conservation districts and watershed conservancy districts. NRD staff reports to an elected Board of Directors. NRD's are charged with proper development and conservation of Nebraska's natural resources. They generate a budget from a tax up to one mill on property in their respective district. Responsibilities include:

1. Approve or disapprove application into Habitat Program.
2. Provide 25% cost share funding for annual lease payment to landowner.
3. Provide tree planting and in the row weed control service.
4. Makes yearly compliance checks of living snowfence to verify it meets Habitat Program criteria.

Federal Government

The Soil Conservation Service, U.S.D.A., in this case. Responsibilities include:

1. Assist county in making landowner contacts.
2. Provide technical assistance in the design and feasibility of the living snowfence planting.

Cost Analysis and Comparison: Living vs. Slatted Snowfence

As mentioned before, tree planting offers multiple benefits. Unfortunately, many of the benefits derived are difficult to assess a value. As a general rule, the intangible benefits far outweigh the tangible benefits. Thus, the problem of developing economic data on a windbreak has always been difficult.

However, in the case of a living snowfence, there is a way to assign a dollar value. This can be accomplished by comparing the cost of a conventional slatted snowfence with a living snowfence.

The best explanation in this case is through the comparison of advantages and disadvantages of each snowfence practice.

Living Snowfence

The use of trees as a living snowfence has been long recognized but not used extensively.

Advantages:

1. Long life of materials, specifically trees, (see Table 1).
2. Low cost/mile/year, (see Table 3).
3. Greater snow storage; failure and road closure minimal.
4. Provide wildlife habitat
5. Aesthetically pleasing.
6. Provide erosion control.
7. Provide livestock protection.

Disadvantages:

1. Time lag initially before trees will start trapping equal amount of snow. Anywhere from 3 to 5 years to attain 4 foot height.
2. Take up more space.
3. Psychological twist. People (i.e. county road personnel) are not familiar with working with trees.

Slatted Snowfence

The use of slatted snowfence along road right-of-way has long been a popular way to prevent road closure.

Advantages:

1. Erected and in use very quickly.
2. Psychological twist in that the people (i.e. county road personnel) are working with something they understand better than trees.
3. Minimal space used.

Disadvantages:[2]

1. High annual maintenance costs, generally must put up and take down every year, (see Table 2).
2. Short life of materials, specifically cribbing, (see Table 2).
3. High cost/mile/year, (see Table 3).
4. Limited snow storage capacity. Two or more severe blizzards can fill a slatted snowfence, causing failure and road closure.

As Tables 1 and 2 show, the cost/mile of a slatted snowfence is greater than the living snowfence with or without the Habitat Program. The two factors making the slatted snowfence so expensive are short life span of materials and high annual maintenance costs. A living snowfence has minimal annual maintenance costs after tree establishment (generally 3 years) and the materials (i.e. trees) are extremely long-lived.

Spreading the costs out over the life span of each practice is where the Living Snowfence Program excels. Slatted snowfence ranges from 11 to 27 times as costly as a living snowfence! This is shown as cost/mile/year in Table 3.

In this situation, the tax supported entity (i.e. county government) is the one carrying the annual cost of a slatted snowfence. Thus, the bottom line in the interest of the county is the amount of money to be saved. The comparison of the two snowfence practices will show that the living snowfence is by far the most efficient method of saving taxpayer's money. This is expressed in savings/mile/year, as shown in Table 4.

All of the cost data shown in the tables is based on May, 1982 costs. trying to predict the cost of materials or wage rates 10 to 50 years in the future is unrealistic. Thus, no projections were made. In essence, the cost and savings comparisons are based on zero inflation.

Of course, we all know that history tends to repeat itself. Our country's economy is cyclic, with periods of inflation and recession. Thus, it can be assumed that the price of materials and labor will continue to increase at an unknown rate. This increase will tend to affect the slatted snowfence more so than the living snowfence, since slatted snowfence is so labor intensive. More specifically, the cost/mile/year will increase, thus, making the Living Snowfence Program more economically attractive than it already is today.

Summary

The use of a tree planting as a living snowfence has been discussed. The cost comparison of a slatted versus living snowfence yielded interesting, if not shocking results. Spreading maintenance and material costs out over the life span of each practice proved the living snowfence to be the most cost effective. A slatted snowfence can be anywhere from 11 to 27 times as expensive to prevent road closure as compared to aliving snowfence.

A living snowfence is far superior in its capacity to store snow. An established living snowfence at age 7 has already proven to withstand two severe winters without failing. A slated snowfence on the same road has failed, thus, causing road closure.

It should be recognized that these cost data are actual expenses incurred by each practice. The figures are May, 1982 costs; no inflation factors have been used. Also, such factors as minimal snow plow time and labor associated with a living snowfence were not included. These costs do exist where a slatted snowfence commonly fails in severe blizzards. The living snowfence has yet to fail in keeping the road open.

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Table 1. Living Snowfence Cost Summary: Cost per Mile[1/2/] (Approximation)

ITEM		COST ($) No Habitat Program	COST ($) Habitat Program
Planting Stock			
Year 1: 4,180 trees @ 26¢/tree	$1,087		
Year 2: Replants 80% survival	+217		
Year 3: Replants 90% survival	+109		
Subtotal	$1,413	$1,413	$ 0[3/]
Tree Planting			
Year 1: Complete Service	$ 711		
Year 2: Replants, hand	+142		
Year 3: Replants, hand	+ 71		
Subtotal	$ 924	$ 924	$ 924
Site Preparation (summer fallow)			
Spring, prior: plow 1 pass	$ 67		
Summer, prior: disc, 2 passes	+ 88		
Spring, Year 1: disc 1 pass	+ 44		
Subtotal	$ 199	$ 199	$ 0[4/]
Weed Control, In Row			
Year 1, Spring: Simazine WP, 2 lbs. AI/AC	$ 93		
Year 2, Fall: (same as above)	+ 93		
Year 3, Fall: Simazine WP, 4 lbs AI/AC	+ 93		
Subtotal	$ 279	$ 279	$ 279

Weed Control, Between Row			
Seed, Cover crop (milo) Year 1, 2, 3	$ 35		
Seed, grass (Short-medium warm season) Year 4	+146		
Subtotal	$ 181	$ 181	$ 0 3/
Plant, cover crop (Shredder, 12' disc, 8' drill) Year 1, 2, 3,	$ 153		
Plant, grass (8' (8' drill) Year 4	+ 75		
Subtotal	$ 228	$ 228	$ 228
Fence			
Material (Posts, wire staples, braces)		$1,375	$ 0 3/
Construction (labor, equipment)		$1,365	$1,365
Maintenance (mend @ 5 year intervals)		$1,150	$ 0 4/
TOTAL COST/MILE:		$7,114	$2,796

1/ State: Nebraska
County: Valley
NRD: Lower Loup
Site: Gently rolling upland, 0-5% slopes
Soil: Heavy (loam or sandy loam)
Existing Vegetation: Rangeland sod

2/ Tree life span = 50 years
Trees per mile (4 rows) = 4,180

3/ Cost paid by Nebraska Game and Parks Commission Habitat Program

4/ Cost Paid by private landowner

Table 2. Slatted Snowfence Cost Summary: Cost per mile[1/] (Approximation)

ITEM		COST ($)
Material, Fence		
Steel Posts:		
330 posts/mi.x $270/post/2	$ 446	
Slatted Cribbing:		
106 rolls/mi. x $31.50/roll	+3,339	
Subtotal:	$3,785	$3,785
Labor, Fence		
Putting up (30 min./roll, 7 men)		
7 men x $5.00/hr x 7.6 hrs./mi		
= $266/mile/yr.	$1,330	
Taking down		
Same as cost of putting up	+1,330	
Subtotal:	$2,660	$2,660
Equipment, Fence		
Putting up		
Jeep: 7.6 hrs./mi. x $3.50/hr =	$ 27	
Pickup: 7.6 hrs./mi. x $5/hr =	+ 38	
Truck: 7.6 hrs/mi. x $7/hr =	+ 53	
	$118/mi./yr.	
$118/mi./yr. x 5 years	$ 589	
Taking down		
Same as cost of putting up:	589	
Subtotal:	$1,178	$1,178
TOTAL COST/MILE		$7,623

1/ Slatted snowfence life span = 5 years.
Steel post life span = 10 years.

Table 3. Cost Comparison-Living vs. Slatted Snowfence: Cost per Mile per Year

SNOWFENCE PRACTICE	COST ($)
Living	
No Habitat Program	
$7,114/mi./50 years	$ 142
Habitat Program	
$2,796/mi./50 years	56
Slatted	
$7,623/mi./5 years	$1,525

Table 4. Savings Comparison-Living vs. Slatted Snowfence: Savings per Mile per Year

SNOWFENCE PRACTICE	SAVINGS ($)
No Habitat Program	
$1,525/mi./yr., Slatted - 142/mi./yr., Living $1,383/mi./yr.	$1,383
Habitat Program	
$1,525/mi./yr., Slatted - 56/mi./yr., Living $1,469/mi./yr.	$1,468

Living Snowfence - Colorado

By: Ed Olmsted, State Staff Forester
Soil Conservation Service, Denver, CO

PROBLEM - Blowing Snow Management

Under a grant from the USDA Forest Service to the Colorado State Forest Service, a Snow Management Technology Transfer Pilot Project was initiated.

Dale Shaw, Director of Technology Transfer scheduled a meeting in Denver, Colorado, in October 1982 to inform and promote the living snowfence concept in Colorado. Doak Nickerson was the featured speaker and he explained the Nebraska program. The aim was to establish a few living snowfence demonstration areas. The meeting brought together personnel from a variety of agencies with various interests, Colorado State Forest Service (CSFS), Colorado Division of Wildlife (DOW), Colorado Division of Highways (DOH), several counties sent road department representatives, Agricultural Stabilization and Conservation Service, Agricultural Research Service, U.S. Forest Service, Soil Conservation Service (SCS), Extension Service, Colorado State Conservation Board, Colorado Association of Soil Conservation Districts.

The reception of the program by the attending agency representatives was very enthusiastic. It was decided to enlist the aid of SCS Area Conservationists in NE Colorado, in targeting a few areas for 1983 proposals. John Berst, CSFS, District Forester and myself were designated to assist Dale Shaw, in getting the program off the ground.

The first step was to meet with and discuss the program at local meetings in the targeted areas, with interested local representatives of the Soil Conservation Districts, DOW, DOH, County Commissioners and road departments. For the most part, these local people were sold on the program. SCS District Conservationists did the leg work in developing the individual proposals.

From the idea of a few sites targeted in the NE quarter of Colorado, nineteen proposed plans were received from all sections of the state. Twelve have been installed, with one more to go.

Over three miles of living snowfence were set in place. The individual lengths range from 400 to 6100 feet long.

If there is interest in your state, some of the items to think about include:

1. Involve local agency representatives in the initial planning stages.

2. Have all involved agencies designate a representative, so local people will know whom to contact.

3. Decision-making needs to be on the local level or as close as possible.

4. Fiscal Year - Differences in the start of government agency fiscal years complicates funding and planning.

5. Use a working agreement, develop one to suit each proposal. This ties down responsibility.

6. Maintenance plans need to be developed for at least three years following planting.

7. Publicity - News articles, local TV and radio coverage, and signs giving credit to all involved will really help promote the program. It may be a good idea to check survival before placing a sign at a site.

Guidelines

Living Snowfence Planning and Establishment

BACKGROUND

The living snowfence effort is truly a cooperative program. During the spring of 1983, 13 demonstration plantings were established in Colorado through contributions of time, money, manpower, materials, and/or land from the following:

- Soil Conservation Service
- Colorado Division of Wildlife
- Colorado State Forest Service
- State Soil Conservation Board
- Colorado Department of Highways
- USDA Forest Service
- Private Landowners
- Private Industry
- Extension Service
- Soil Conservation Districts
- County Commissioners
- National Park Service
- Agricultural Stabilization Conservation Service
- USDA Agri. Research Service

All personnel, especially those in field offices, performed exceptionally well. This despite the program's late start and subsequent lack of complete communications. A few problems, primarily related to a lack of communication and/or clearly-defined chain of command, were experienced.

OBJECTIVES

Guideline objectives are aimed at helping solve those problems mentioned above. Also, guidelines are aimed at making the entire living snowfence planning and installation process run as smoothly and efficiently as possible.

ORGANIZATION

Following is an outline of general program communication organization. Please keep in mind that this is FOR COMMUNICATION ONLY and isn't intended to show who reports to whom or other supervisory structure. This structure is aimed at helping to show where to go for various kinds of information.

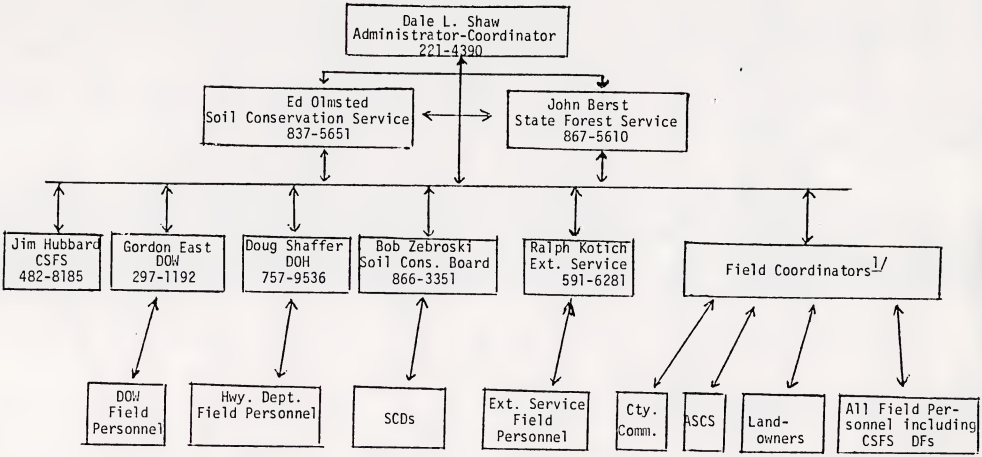
FIELD LEADERSHIP

A suggestion is that one person assume responsibility for planning and coordinating all efforts needed to get a specific living snowfence established. This person is known as the field coordinator. This person doesn't necessarily have to do all the work--it means that he or she serves as coordinator, provides information, and sees that needed tasks are done.

SITE SELECTION--NEEDS ASSESSMENT

Site selection is done by those who best know local conditions and needs. State and county road personnel know where critical road closure areas are. Division of Wildlife people know whether or not plantings can benefit area

LIVING SNOWFENCE COMMUNICATION STRUCTURE



Field personnel should contact their agency representative regarding agency policy, resources to be provided by their agency, or other questions specific to their agency. The contact for field personnel on general information about a proposed planting is the field coordinator for that project.

1/ The local person who organizes and coordinates all activities relative to planning and establishing a specific living snowfence.

wildlife. SCS field personnel and others who work with landowners know which planting sites are likely to be available.

Those mentioned, plus other interested parties, can mutually agree on best planting sites and priorities.

INITIAL PLANNING AND ANALYSIS

Once agreement is reached that a planting can fill assessed needs, a number of questions should be answered regarding that particular site. Honest answers to these questions early on may save headaches and wheelspinning later. Answers also provide a basis for the working agreement which is required for all plantings.

A suggestion is that the checklist which follows be used as a handy preliminary or initial planning and analysis tool.

LIVING SNOWFENCE CHECKLIST

A. Site Location _____

_____

B. Landowner _____

C. Current land use _____

D. Is land available for living snowfence planting? _____

E. Will landowner donate land? _____ Lease? _____ Lease rate _____

_____

F. Site preparation needed _____

_____

Who will do site prep? _____

When will site prep be done? _____

G. Who will plan the planting? _____

H. Who will secure planting stock? _____

I. Who will do the planting? _____

J. When will the planting be done? _____

K. Will water needs be supplied by drip or mulching? _____

Who will provide materials? _____

Who will install? _____

When will installation be done? _____

Who will operate drip system if one is used? _____

L. Who will provide fencing materials? _____

How much will fencing materials cost? _____

Who will install? _____

M. Who will provide fertilizer tablets? _____

Checklist (continued)

N. Who will provide protection from rabbits, other pests? _____

_____. How? _____

O. Who will provide weed control? _____

How? _____

P. Who will provide shingles or other wind protection? _____

_____

Q. Will cover crop of sorghum, wheat, or other material be planted between rows to catch snow an provide wildlife habitat? _____

If so, what kind of crop? _____

Who will do planting? _____

R. Who will monitor planting during the summer to see if problem exist? _____

S. Who will do survival check and order replacement seedlings next spring? _____

Who will do replacement planting? _____

T. Other considerations _____

GENERAL RECOMMENDATIONS

Though little research has been done on specifics of living snowfences, experience shows that certain basics seem to apply. The following is provided for consideration in planning and establishing living snowfences.

Location--Drift distance is the important consideration when deciding how far the leeward row should be from the road. At least three important factors influence drift distance. These are (1) character of ground cover to windward, (2) terrain to windward (fetch distance) and (3) whether terrain slopes upward or downward from the windward side. In general, the taller the ground cove to windward, the less drifting. Fetch or delivery distance refers to flatness of terrain to windward. In general, there is less drifting if upwind land slopes down toward the barrier as opposed to sloping upward for a distance to the windward side. Fetch distance is increased where long stretches of open terrain lies to windward. In summary, less drifting is expected (1) in rough terrain with tall vegetation, (2) where terrain slopes toward the barrier, (3) where vast open spaces do not exist to windward, and (4) where vegetation exists to windward as compared to open ground.

Normally, drifting can be expected to occur up to 30 times barrier height with single row barriers or with one structure. A safe rule to follow in flat, open prairie land is to place the barrier's (living snowfence) leeward row at least 200 feet from the road's edge.

Length--A rule of thumb is to extend both ends of the barrier at least 100 feet beyond the area to be protected. Another "rule" is that the shortest barrier, to be effective, should be at least 30 times height. The reason for these "rules" is that snow sweeps around the ends of any barrier and is deposited leeward and toward the barrier's center for a distance of up to 100 feet.

Site Preparation--Site preparation the fall before planting is strongly recommended on all except tilled land or land sandy enough to be subject to blowing. One way to prepare sites is deep plowing in the fall, leave rough over winter, then work just before planting. If soil is sandy but hasn't been tilled recently, plowing, working down, and planting a cover crop such as sorghum may be done the summer prior to planting. Another possibility is to plow 6 foot wide strips in sandy soil the fall before planting, let lay rough over winter, then work just before planting.

Mulching--Many of us think in terms of drip systems for all plantings. The Division of Wildlife has experienced good success with sheets of plastic placed over the planting site following planting. Plastic is covered to prevent it blowing away and to stop plant desiccation by sunlight reflected from the plastic.

Mulching has advantages of (1) being less expensive than drip, (2) requires no water supply, and (3) provides weed control.

If desired, plastic can be placed to extend three or more feet along each side of seedlings instead of covering entire planting site.

Planting--A common error in planting is that seedlings are not put in deep enough (planted too shallow). Tops of pots and portions of roots on bareroot seedlings either stick out immediately after planting or after the soil settles. It is easy to plant too shallow but difficult to plant too deep. Though not recommended, experiments with pine seedlings revealed that such seedlings survived and grew when planted with only the terminal shoot showing.

A second common error is not getting soil packed firmly around newly-planted seedlings. Packing should be done from the bottom of the hole upward with hand planting. When machine planting, have someone follow the machine to straighten seedlings and be sure soil is packed firmly around them.

WORKING AGREEMENT

The working agreement spells out specifically who will do what, when they will do it, and who will provide resources to get it done. It is the field coordinator's job to formulate the working agreement and get it signed. This is to be done as early as possible and not later than September 15. A major reason for this is so needed site preparation can be done in the fall before the soil freezes.

The signed agreement means all needed resources are available and committed to the project.

The following three pages show sample working agreements based on 1982-83 demonstration plantings. Each field coordinator is free to structure working agreements to meet specific situations.

SAMPLE

WORKING AGREEMENT FOR
LIVING SNOWFENCE AND WILDLIFE HABITAT

Landowner Agrees To:

1. Provide a strip of land 250 feet wide and 3700 feet long as shown on the enclosed map. Prepare site by deep plowing and disking.

2. Erect fencing to protect the planting.

3. Plant all trees and shrubs.

4. Install drip system. Provide water source and water trees and shrubs.

5. Provide weed control and other maintenance.

SCD Agrees To:

1. Provide $1200 toward purchase of drip system.

2. Provide fertilizer tablets and rabbit guards.

Division of Wildlife Agrees To:

1. Provide $1000 toward purchase of drip system.

State Forest Agrees To:

1. Provide 740 Hansen Rose, 370 Russian olive, and 833 Rocky Mountain Juniper.

LANDOWNER _____ Date _____

DIVISION OF WILDLIFE _____ Date _____

SCD _____ Date _____

STATE FOREST SERVICE _____ Date _____

SAMPLE

WORKING AGREEMENT FOR LIVING SNOWFENCE AND WILDLIFE HABITAT

Landowner Agrees To:

1. Provide a strip of land 275 feet wide and 2600 feet long as shown on the enclosed map. Prepare site by deep plowing and disking.
2. Provide water for the drip system.
3. Maintain planting to include weed control, watering, and rodent control.

County Commissioners Agree To:

1. Provide $1250 to help cover cost of materials.

SCD Agrees To:

1. Provide $200 to help cover cost of materials.
2. Supply drip system at cost and install this system.
3. Plant trees and shrubs

Division of Wildlife Agrees To:

1. Provide fencing and erect fence.
2. Seed wildlife cover between road and planting
3. Provide sign for planting.

State Forest Service Agrees To:

1. Provide 300 American plum and 270 Eastern redcedar seedlings.

LANDOWNER _____ Date _____

COUNTY COMMISSIONERS _____ Date _____

SDC _____ Date _____

DIVISION OF WILDLIFE _____ Date _____

STATE FOREST SERVICE _____ Date _____

SAMPLE

WORKING AGREEMENT FOR
LIVING SNOWFENCE AND WILDLIFE HABITAT

Landowner Agrees To:

1. Provide a strip of land 240 feet wide and 1000 feet long as shown on the enclosed map.

Division of Wildlife Agrees To:

1. Be responsible for site preparation. Site preparation will consist of deep plowing and working soil to a suitable seedbed.
2. Provide fencing materials and be responsible for fence erection.
3. Provide labor and equipment to plant trees and shrubs.
4. Be responsible for installing drip system.
5. Provide maintenance following planting. This will include watering, rodent control, and weed control on a 3 foot wide band along the tree and shrub rows.
6. Plant milo between rows for wildlife habitat and for snow storage.

Colorado State Forest Service Agrees To:

1. Provide 267 Eastern red cedar and 83 Russian olive seedlings.

LANDOWNER _____ Date _____

DIVISION OF WILDLIFE _____ Date _____

STATE FOREST SERVICE _____ Date _____

SURVIVAL CHECKS AND EVALUATION

We can gather valuable information by checking survival and making other evaluations at least once a year following planting. One suggestion is to make formal checks in late fall or winter so replacement seedlings can be ordered at that time. This does not mean that periodic checks of plantings shouldn't be made at other times.

The following page shows a suggested form for use when making a survival check and evaluation. Our suggestion is that copies be made for the landowner, your files, and a copy sent to Ed Olmsted, SCS, P.O. Box 17107, Denver,CO 80217 or to John Berst, State Forest Service, 1117 East Burlington, Fort Morgan,CO 80701.

The form shown on the following page is a first draft and can be altered if necessary. Should you have suggestions for altering this form or suggestions on anything contained in these Guides, please make this known to your agency representative or field coordinator.

LIVING SNOWFENCE SURVIVAL AND EVALUATION SHEET

1. Location _____

2. Landowner _____

3. Landowner address _____

4. Site preparation: Month _____ Year _____

   How prepared? _____

5. Species information: (Start with windward row as Row #1)

Row No.	Species	Potted (P) Bareroot (B)	Number Planted	Spacing in Row	Percent Survival	Date Checked
1.						
2.						
3.						
4.						
5.						

6. Date planted _____

7. Soil wet _____ dry _____ at planting time.

8. Tree and shrub condition on date checked: Good ___ Medium ___ Poor ___

9. Planting clean cultivated: Yes ___ No ___

10. Cover crop used: Yes ___ No ___. If yes, what kind? _____

11. Drip system used? Yes ___ No ___. Irrigation adequate? Yes ___ No ___

12. Mulching used? Yes ___ No ___. Did it work well? Yes ___ No _____

13. Planting fertilizer? Yes ___ No ___. Is height growth satisfactory?

    Yes ___ No ___.

14. Your best estimate of cause of mortality on trees/shrubs which died.

    _____

15. Is there rodent damage to trees/shrubs? Yes ___ No ___. Was a repellent

    used? Yes ___ No ___. Name of repellent used _____

16. If there are other comments, use back of this sheet.

Wyoming and Living Snowfence
By: Dan Perko

There are probably as many ways to initiate a living snow fence program as there are states or agencies. I will focus my presentation on Wyoming's approach to getting the first three living snowfence sites planted.

In 1980, an exchange of letters between the Commissioner of Public Lands and Farms Loans and the Superintendent and Chief Engineer for the Wyoming Highway Department (WHD) both expressed an interest in tree planting. The Wyoming State Forestry Division (WSFD) is a part of the Public Land Office. Although no trees were planted until 1983, this did lay the ground work for our living snowfence program.

Dale Shaw, Director of a Blowing Snow Technology Transfer Project for Colorado and Wyoming, called me in July, 1982. He had just returned from a trip to the Lower-Loup Natural Resource District in Nebraska. While there, Dale met with Dick Beran of the district, and discussed the living snowfence program.

Dale was excited about what he had heard and seen and asked me to come to his office. He wanted to know if I might be interested in exploring the use of living snowfence in Wonderful Wyoming.

With equal zeal, I raced (55 mph) back to Cheyenne and contacted the WHD to gain their reaction to the idea. With Lynne Musser, Landscape Agronomist for WHD, costs were calculated for the Wyoming Design board snowfence. I also estimated costs for living snowfence planting. Here I must explain that in Wyoming, like Texas, everything is bigger. The traditional four foot high slated snowfence grows to eight to twelve feet high in Wyoming. It is important to realize the difference in fencing before you look at the costs and think that I misplaced a decimal point.

Cost Comparison

12 foot high, slatted, wooden snowfence	$ 90,000 per mile
Maintenance, (25 yr useful life) @ $.25 per lin. ft/yr	33,000 per mile
Total	$123,000 per mile
3 row living snowfence, materials, labor maintenance (50 yr. minimum useful life)	$ 70,000 per mile

Yearly cost/mile comparison

12 ft wooden snowfence $123,000/25 yrs. = $4,920/yr
3 row living snowfence $70,000/50 yrs. = $1,400/yr

OR

a yearly estimated SAVINGS of $3,520/mile

Our next step was to have a meeting and invite any agency who we thought might benefit or have expertise necessary to implement such a project. On September 1, 1982 a meeting was held. Those invited included WHD administrators, engineers and researchers, Wyoming Game and Fish Department, University of Wyoming Agricultural Extension Service, local district and State Office levels, Wyoming County Commissioner's Association, local county road and bridge supervisors, Director Technology Transfer Project and WSFD. A key in holding the meeting is to have agency representatives with authority to make some kind of commitment for their agency, not just a representative.

Doak Nickerson, Nebraska Department of Forestry, Fisheries and Wildlife, presented a program on their living snowfence project. We then compared board snowfence costs to living snow fence costs. If one had good figures you could also include other benefit values and offset them against the board snow fence costs making a living snow fence planting even more cost effective. Other benefits include protection of livestock, wildlife habitat improvement or creation, decreased expenses for snow removal from roadways and aesthetic values.

Since we were trying to develop a cooperative project, all agencies were asked what they could contribute. Some agencies could provide manpower to reduce costs of planting, etc., others were able to contribute money towards the planting. In a cooperative effort no one agency bears all the costs. Dollars spent will go farther for each agency and more benefits derived form the money spent creating a better benefit/cost ratio. A breakdown of agency contribution, both dollars and manpower equivalents is included as Appendix A.

Sites were selected for the demonstration plantings in October, 1982 with three basic criteria. Sites were to be located on State owned land having existing board snowfence and be close to Cheyenne. State owned land eliminated the need to purchase easements and other problems which might arise on private land. Existing board snowfence was necessary since our proposal called for replacing existing board snowfence over time thus eliminating the need for board snowfence replacement. Being close to Cheyenne not only makes frequent visits more feasible but will also make tours with agency heads easier. The plantings are also located on major highways for increased visibility.

Site preparation and planting were delayed because of an exceptionally wet spring. Planting was finally completed in mid-June with personnel from several agencies involved.

Reports on the plantings will be made yearly to WHD and the FHWA. The project is funded for five years with a final report to be written in January, 1988.

Although there are numerous ways to develop a living snowfence program, there are a few keys to consider. A cooperative approach reduces costs for all involved agencies but will generally return the same benefits. Dollar figures and Benefit/Cost ratios will help sell the program. Try to include as many benefits as possible, some should relate to each agency involved. Don't wait to start. It takes several years to develop a working living snowfence. Even if you only plant one you will have something to show people later. Finally, use past successful projects to encourage support for your project.

Hybrid Poplar Cultivars Grow Well in the Black Hills

By: Ardell J. Bjugstad and Danial L. Noble[1]

Abstract

Four of 26 hybrid poplar clones planted as cuttings on a gold mine tailings in the Black Hills exhibited very good survival and growth. Other clones had relatively high (exceeding 50 percent) survival but slow growth (below 60 cm) over a 5-year period.

Introduction

State and federal mining laws require the established vegetation on postmined sites to equal or exceed production and disirability of the premined vegetation. These requirements have encouraged use of genetically improved or selected planting stock. Some of the genetically improved stock has been produced by hybridization.

The use of hybrid poplar began with the introtuction to the United States of Lombardy poplar, Populus nigra L. cv. "Italica" (Rehder 1954). In 1924, hybridization of poplar was initiated in Rumford, Maine by the Oxford Paper Company, now Boise Cascade Paper Group, in cooperation with the New York Botanical Garden. Inter- and intraspecific crosses were made from collections of poplars planted at the New York Botanical Garden and wild trees of Populus Deltoides (Demerett 1981). The USDA Forest Service, Northeastern Forest Experiment Station, is currently testing 199 poplar clones--158 clones form the New York hybridization study and 41 clones from Canada and European selections (Demeritt 1981).

High percentage survival is the first priority to provide spoil cover; the second consideration is rapid growth. Hybrid poplars have been of interest to people who are looking for trees which would become readily established and produce browse for wildlife. This interest is important to people complying with mine reclamation regulations.

This paper discusses the survival and growth of 26 clones of hybrid poplar planted on a gold mine tailing in the Black Hills.

Method

The area of this study was a gold mine tailings dump of about 44 acres. The material consisted of dolomites, quartzite, sandstone and crused shale which had been processed to remove the gold. The material classified as a brown sandy loam soil type.

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1. Authors are Range Scientist, Rocky Mountain Forest and Range Experiment Station, and Department Head, Biology Department SDSM&T, Rapid City, SD

The mine tailings used in this study were very low (0.7%) in organic matter, slightly acidic, and very low in fertility. Soil test indicated NPK was 5, 18 and 140/lb per acre, respectively (South Dakota State University Soil Testing Laboratory). Representative soils contain 2400, 3000 and 48000 lb/acre of NPK, respectively (Lyon et al. 1956). Electric conductivity was 0.2 mmho/cm.

Thirteen cuttings of twenty-six hybrid poplar clones of various parentage were planted in split plot design in the spring of 1978 (Table 1). These clones were grown in the USDA Forest Service Nursery at Coeur D'Alene, Idaho. The clones were supplied in the form of cuttings 3/8 inch diameter and 12 inches long, taken in the fall and stored over winter. Upon receiving the cuttings in the spring, they were placed in control climate coolers until field conditions were ready for planting.

The planting medium, of relatively sandy loam texture, allowed easy planting with the use of a dibble. The dibble was designed to be slightly larger than the diameter of the cutting and long enough to allow approximately 2-3 inches of the cutting to protrude above the ground surface. The soil around the planted cuttings was packed against the cutting to insure soil contact. One-half gallon of water was applied immediately after planting.

Survival and height (from tree base to top of terminal bud) was measured after leaf drop, in October. Measurements were recorded annually; but in this paper, results are based on the survival and growth after the fifth growing season.

Table 1. Listing of hybrid poplar clones by clone number and percentage.

Northeastern Station clone numbers	Parentage (female x male)
NE-4	P. nigra x P. laurifolia
NE-9	P. nigra x P. trichocarpa
NE-11	P. nigra x P. trichocarpa
NE-17	P. cv. Charkoviensis' x P. cv. Caudina'
NE-29	P. cv. Charkoviensis x P. trichocarpa
NE-32	P. cv. 'Angulata' x P. 'Berolinesis'
NE-35	P. cv. 'Angulata' x P. cv. Plantierensis'
NE-40	P. cv. 'Petrowskyana' x P. cv. 'Caudina'
NE-42	P. maximowiczii x P. trichocarpa
NE-44	P. maximowiczii x P. cv. 'Berolinensis'
NE-50	P. maximowiczii x P. x Berolinensis
NE-51	P. maximowiczii x P. cv. 'Plantierensis'
NE-52	P. maximowiczii x P. cv. Plantierensis'
NE-53	P. mazimowiczii x P. cv. 'Caudina'
NE-207	P. deltoides x P. trichocarpa
NE-216	P. deltoides x P. trichocarpa
NE-241	P. deltoides x P. cv. Plantierensis'
NE-258	P. cv. 'Angulata' x P. deltoides
NE-278	P. nigra x P. cv. Eugenei'
NE-279	P. nigra x P. laurifolia
NE-302	P. cv. Betulifolia' x P. trichocarpa
NE-316	P. cv. Charkoviensis' x P. cv. Robusta'
NE-327	P. cv. Candicans' x P. x Berolinensis
NE-341	P. cv. Rasumowskyana' x P. cv. Plantierensis'
NE-353	P. deltoides x P. cv. Caudina'
NE-388	P. maximowiczii x P. trichocarpa

Results and Discussion

Survival of the clones after 5 growing seasons ranged from 92 percent to 8 percent, with an average of 58 percent. For simplicity in this paper, the survival top 10 clones ranged from 92 percent to 69 percent, with an average of 78 percent (Table 2). Comparable high survivals have been observed in Nebraska (Bagley 1973) on southern sites of the United States (Maisenhelder 1970) and in southwestern Ontario (Von Althen 1981). One of the best survivors--NE-302 had a low 5-year height growth--the lowest of the top 10 (Table 2). These data indicate NE-341, with a survival of 92 percent and height growth of 77 cm, which is second from the highest height growth of 94 cm, would be considered most encouraging to both survival and height growth.

When using height growth as the major criteria for selection of the most encouraging clone for establishing high performance poplars on tailing in the Black Hills, NE-278 had the greatest height growth of 98 cm after 5 growing seasons (Table 3). However, the survival of NE-278 was only 38 percent--the lowest of the top 10 according to height. Other clones of more encouraging values would be NE-258, 341, 207, and 32 with heights/survivals of 94/69, 77/92, 70/77, 65/69, respectively.

These height growths--94 cm per 5-year period--without cultural treatments are very respectable when considering soil type, precipitation and other studies on mine reclamation (Bjugstad et al. 1981). However, they are somewhat lacking when compared to height growth data from Pennsylvania, Maryland and Pakistan (Table 4). In addition, the cuttings in Pennsylvania, Maryland and Pakistan (Hussain and Sheikh 1981) were planted on soils, compared to the relatively inert mine tailings in the Black Hills.

Table 2. Five-year-survival, in percentage and height, in centimeters, of the 10 hybrid poplar clones with least mortality.

Clone ID	Parentage	Survival %	Height CM
NE-341	P. cv. Rasumowskyana' x P. cv. Plantierensis	92	77
NE-302	P. cv. Betulifolia' x P. trichocarpa	92	28
NE-42	P. maximowiczii x P. x trichocarpa	85	60
NE-50	P. maximowiczii x P. x Berolinensis	85	51
NE-4	P. nigra x P. laurifolia	77	63
NE-207	P. deltoides x P. trichocarpa	77	70
NE-11	P. nigra x P. trichocarpa	69	61
NE-32	P. cv. Angulata' x P. cv. Berolinensis'	69	65
NE-216	P. deltoides x P. trichocarpa	69	63
NE-258	P. cv. Angulata' x P. deltoides	69	94

Table 3. Five-year-height, in centimeters and survival, in percentage, of the 10 tallest hybrid poplar clones.

Clone ID	Parentage	Height CM	Survival %
NE-278	P. nigra x P. cv. 'Eugenei'	98	38
NE-258	P. cv. 'Angulata' x P. deltoides	94	69
NE-52	P. maximowiczii x P. cv. 'Plantierensis'	90	46
NE-35	P. cv. 'Angulata' x P. cv. 'Plantierensis'	88	54
NE-341	P. cv. 'Rasumowskyana' x P. cv. 'Plantierensis'	77	92
NE-40	P. cv. 'Angulata' x P. deltoides	75	46
NE-327	P. cv. 'Candicans' x P. Berolinensis	71	46
NE-207	P. deltoides x P. trichocarpa	70	77
NE-32	P. cv. 'Angulata' x P. cv. 'Berolinensis'	65	69
NE-44	P. maximowiczii x P. cv. 'Berolinensis'	64	46

Table 4. Four-year-height, in feet, of hybrid poplar clones grown in Pennsylvania, Maryland, South Dakota and Pakistan

Clone ID	Pennsylvania[1]	Maryland[1]	South Dakota	Pakistan[2]
NE-17	22	16	2	
NE-41	21	16	2	-
NE-316	19	15	1	-
NE-359	22	16	2	-
DN-22	21	19	-	50

1. According to Demeritt (1981)

2. According to Hussain and Sheikh (1981)

Conclusions

Four of 26 hybrid poplar clones planted as cuttings on a gold mine tailing exhibited very encouraging survival and growth. These four were NE-258 (P. cv. 'Angulata' x P. deltoides), NE-341 (P. cv. 'Rasumowskyana' x P. cv. 'Plantierensis'), NE-207 (P. deltoides x P. trichocarpa), and NE-32 (P. cv. 'Angulata' x P. cv. 'Berolinensis'). Other clones had relatively high (exceeding 50 percent) survival but slow growth (below 60 cm) over 5-year period.

Acknowledgements

Access to and the use of the gold mine tailings provided by Homestake Mining Company is gratefully acknowledged.

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Leafy Spurge--A Potential Conflict with Woody Plants on the Northern High Plains

By: Ardell J. Bjugstad, Richard Francis, and Paul W. Skinner[1]

Abstract

This study found that leafy spurge infestations were dominant on lowland/bottomland range site/topographical positions compared to other range sites/topographical positions.

Introduction

Leafy spurge (Euphorbia esula L.) has become a serious pest of the northern Great Plains. The land area it occupies doubled between 1973 and 1982 in North Dakota (Messersmith and Lym 1983). The species was estimated to occupy at least 2.3 million acres in 1979, with 90 percent of it in a 1,200-mile diameter circle centered near Wolf Point, Montana (Figure 1). This places the northern High Plains in the higly infested area where a considerable portion has been rated as potentially economically impacted. Also the area provides natural wooded draws of high value of wildlife (Urest 1982).

The Plant

Leafy spurge (Euphorgia esula L.) is a herbaceous, deep rooted perennial of the spurge (Euphorbiaceae) family (Messersmith 1983). Leaves are simple linear to oblong and have milky sap which is typical of the spurge family. The spurge family is large, and includes the poinsettia (Poinsettia dentata) and castor-oil plant (Ricinus communis), often grown as an ornament. All wild members of this family in the northern High Plains belong to the genus Euphorbia (Stevens 1950).

The depth and longevity of the root system has made this plant very persistent. The root system has the capability of producing new shoots from various depths and from mere fragments of roots (Messersmith 1983). Root systems, with no mortality, have lived 6 years during the development of the plant (Selleck et al. 1962).

The most colorful parts of the plant are the yellowish-green-bracts (not petals as in more common flowers) which represent the flower. Sepals and petals are absent (Hanson and Rudd 1933). A seed stalk can produce up to 150 seeds. Seeds are thrown up to 15 feet when the ripe fruit dehisces explosively. Most seeds germinate in the spring, when air temperatures reach the low 80's, but some germinate later (Messersmith 1983). Most (99 percent) of the viable seeds germinate within 2 years, but others remain viable up to 8 years.

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1. Authors are Range Scientists, and Soil Scientist, respectively, Rocky Mountain Forest and Range Experiment Station.

The seeds are about the size and shape of pearl millet--2 to 2.5 mm long. This makes them attractive to large and small birds, such as the sharptailed grouse (Pedioecetes phasianellus) and field sparrows (Spizella pusilla). One sharptail grouse dropping collected near an extensive infestation of leafy spurge contained 490 seeds with 200 seeds identified as leafy spurge (Noble 1980). Of the 490 seeds, 51 germinated 2 of which were leafy spurge. Birds are considered primary disseminators of spurge seed.

These plant characteristics--ease of root sprouting, deep-roots, large highly viable seed--have made leafy spurge a successful invader, very persistant once established, and difficult to control.

Soil-Site Relationships

Leafy spurge is a native to the central Caucasus Region of Eurasia and found across Europe (Sellect et al. 1962). It grows in dry, subhumid, and subtropic and subartic conditions. It grows along waterways or on dry uplands (Morrow 1979), and is found on ridges, floodplains, riverbanks, and mountainslopes (Bakke 1936). It is present in a variety of topographic positions, from the flat beds of glacial lakes to the slopes of sand dunes and glacial moraines (Selleck et al. 1962). Seedling emergence and survival was eight times greater on a cultivated areas than a patch of western snowberry (Symphoricarpos occidentialis). This indicates that seedling survival was severly restricted but not prevented by competition (Best et al. 1980).

A recently completed study determined those soil and site factors that correlated were significantly with leafy spurge density and percentage of foliar cover (Skinner 1982). The study was conducted near Devils Tower National Monument, in northeastern Wyoming. The study area was selected because of the relatively high density and longevity of the leafy spurge stand. In addition, a variety of topographic, geologic, edaphic and vegetation features existed within the area. Twenty-six 0.1-acre plots were used to represent different soil map units and range sites including high, medium and low leafy spurge foliar cover. The four range sites were lowland, sandy, loamy and clayey.

The data indicated that sand in the 0- to 10-inch layer was significantly higher where leafy spurge occurred than on sites without leafy spurge (Table 1). However, the clay content of the soil below 10 inches was significantly less in the area infested with leafy spurge compared to sites without leafy spurge. This suggests that leafy spurge occupied sites where the soil had a higher sand content and may be the initial location of the leafy spurge infestation.

According to foliage cover, leafy spurge was ranked as dominant on the lowland range site, second on sandy range sites, and of considerable lower ranking on loamy and clayey range sites (Table 2). This relationship, with the corresponding range site topographic position, is depicted in Figure 2. The highest dominance ranking occurred on bottomland positions, with less on toeslope (bottom of slope) and shoulder slope, and summit positions.

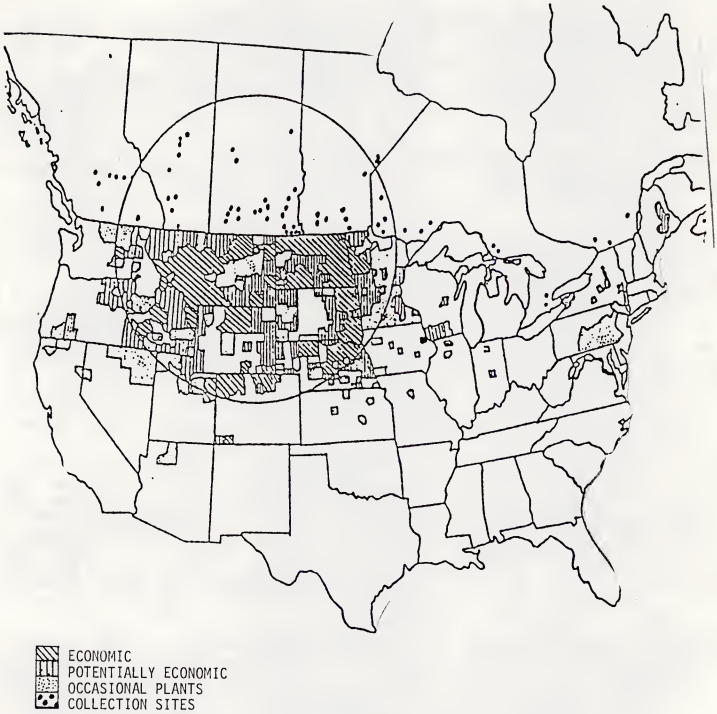

Fig. 1. Distribution and economic rating of leafy spurge. Ninety percent of infestation defined in a 1,200 mile diameter circle centered near Wolf Point, Montana (from Noble, Dunn and Andres 1979).

Table 1. Comparison of sand and clay content of plots and without leafy spurge over all range sites (modified from Skinner 1982).

	Mean Values			
	Without Spurge		With Spurge	
% Sand (0-10")	33+	5.63[1]	45+	3.53*
% Sand (greater than 10")	34+	2.96	31+	2.34
% Clay (0-10")	28+	4.29	22+	2.15
% Clay (greater than 10")	36+	4.54	25+	2.51**

1. Standard error
* Significant at alpha = 0.05.
** Significant at alpha = 0.01.

Table 2. Speices ranking[1] to percent foliage cover on different range sites (modified from Skinner 1982).

		Range Sites					
Dominant spp.	Lowland		Sandy	Loamy		Clayey	
		FC[2]		FC		FC	
1	EUES[3]	20+5[4]	BOGR	39+5	BOGR	19+3	AGSM	9+1
2	SPCR	15+3	EUES	31+7	POA	9+2	OPPO	4+2
3	RACO	13+4	POA	10+2	CARE	8+1	STVI	4+2
4	BOGR	11+3	AGSM	8+2	AGSM	7+1	LEPI	3+1
5	POA	9+3	SPCR	8+2	BOCU	4+1	SCPO	3+1
6	STCOI	7+2	BUDA	4+2	ANGE	4+1	EUES	3+1
7	CALO	4+2	BRJA	4+1	EUES	4+1	GUSA	2+1
Diversity av. spp. / plot	11		13		20		10	
EUES dominance % FC[2] EUES / TOT FC	20.0		26.1		3.6		7.2	

1. Ranking based on average % FC for each species divided by total % FC for each range site with highest % given a ranking of 1.

2. FC = foliage cover.

3. EUES = Euphorbia esula; SPCR = Sporobolus cryptandrus; RACO = Ratibida columnifera; BOGR = Bouteloua gracilis; POA = Poa spp.; STCOI = Stipa comata; CALO = Calamovilfa longifolia; AGSM = Agropyron smithii; BUDA = Buchloe dactyloides; BRJA = Bromus japonicus; CARE = Carex spp.; ANGE = Andropogon gerardii; OPPO = Opuntia polyacantha; STVI = Stipa viridula; LEPI = Lepidum spp.; GUSA = Gueierrezia sarothrae.

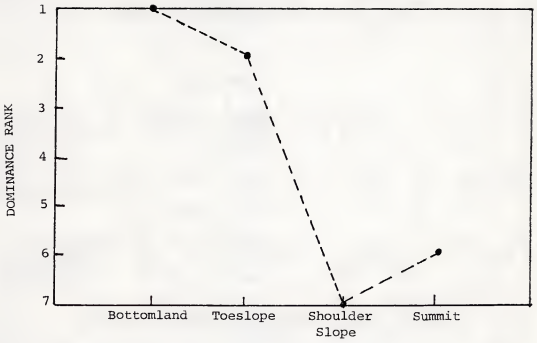

Fig. 2. Dominance rank according to foliage cover with highest as No. 1 of leafy spurge on different topographic positions (modified from Skinner 1982).

Leafy spurge assumes a highly competitive role on lowland range sites and bottomland topographic positions. These sites also have been described as prairie woodland sites (Boldt 1978, Boldt et al. 1978).

Conclusions

Lowland range sites and bottomland topographical positions on the northern High Plains have been described as actual or potential prairie woodland sites. They have recently been described as sites where leafy spurge dominates over other herbaceous vegetation in the community. Efforts to control the noxious weed with chemicals will also affect hardwood species on these sites or prohibit regeneration of hardwood species. These data suggest management closely monitor lowland and sandy range sties for investations of leafy spurge and immediately instigate control efforts at initial infestation.

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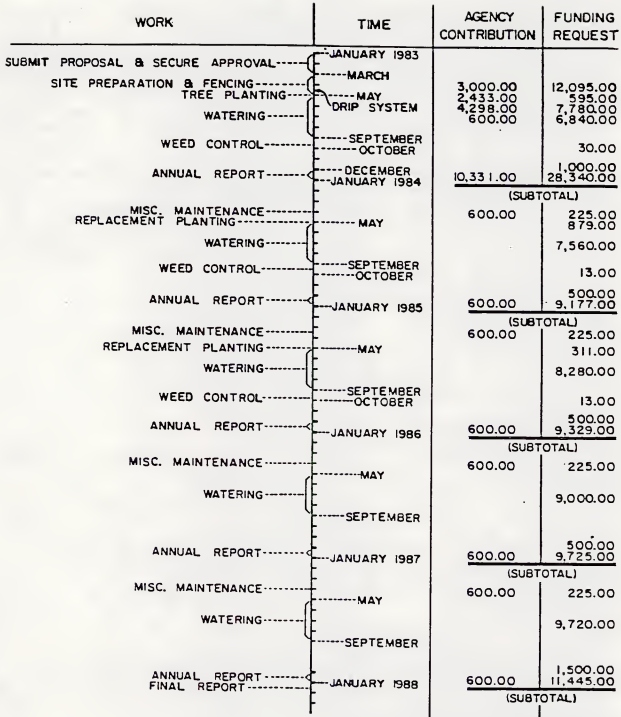
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Windbreaks and shelterbelts have been around for a long time. Their benefits are known to just about anyone who has taken a basic course in conservation or has stood behind a tree or shrub on a windy day. Why then are many farmers or ranchers not planting windbreaks or shelterbelts? How can we motivate them to do so? For these reasons, our program to day is aimed at helping us understand just what makes a landowner tick. What makes them do what they do and how we can motivate them to apply well known and highly beneficial conservation practices.

Our program today will consist of three speakers. First, Bob Minor, Management Improvement Specialist from the U.S.D.A. Forest Service Denver will present a program on "Motivating Landowners and Almost Everybody Else". We will also hear from Ervin Schuster, Forest Economist with the Forestry Sciences Lab, Missoula, Montana, on targeting landowners for assistance and then with the help of Dick Bavit learn about the results of a Conservation Practice survey recently completed in Nebraska by James Brandle of the University of Nebraska.

Motivating Landowners and Almost Everybody Else

By: Bob Minor
Organization Management Specialist
USDA Forest Service
Denver, Colorado

The following is a brief summary of Bob Minor's presentation on motivation. Due to the nature of the topics, the interactive instruction used, films and participation of the audience, it was not practical to prepare a transcript of the program.

At some point in time we are all salesmen. We must sell ourselves to just about everyone we deal with whether we are selling a product or an idea. We are also no different than any other person in that we all have values, feelings and attitudes that determine what we do and how we react to others. Much of the discussion centered on the motivational needs of individuals developing trust and evaluating ourselves to determine how we can improve in our relationship to others. Some of the individual worksheets are located in the appendix. Completing them will give the reader a feel for what was presented and some good food for thought.

The Montana Division of Forestry would like to thank Mr. Minor for his contribution to the G.P.A.C. Forestry Committee.

Targeting Landowners*
By: Ervin G. Schuster

Forestry organizations administering private forestry assistance (PFA) programs and some private businesses have a similar need: they must market their product to the right people, at the right time, and in the right manner. This paper addresses the general problem of identifying the right people, the type(s) of landowner(s) that would likely be good prospective clients for assistance programs. Two analytical techniques are well-suited: the discriminant analysis and the logistic regression analysis. Either technique can facilitate identifying the most likely clients, and has the potential of substantially increasing the effectiveness of forestry assistance programs.

The logistic regression function estimates the probability that an individual belongs to one of two groups. These groups could be variously labeled, such as "likely" and "unlikely" PFA clients. Data are normally obtained from a random sample of individuals (landowners), such as through a questionnaire. Measurements are taken both on the dependent variable (likely/unlikely) and independent variables (landowner attributes such as age, education, etc.). These data are then used to estimate the logistic regression function. For a set of attribute measurements on a "outside" landowner, one not used in the original data base, the completed logistic model might predict that the landowner has a 90 percent probability of being a "likely" client. This technique was applied in western Montana to assess landowner use of the PFA program.

The discriminant function is intended to assign or classify an object into one of two (or more) classes. It can use the same data base as the logistic regression function. But the completed model results in a classification operation, not determination of probability. For example, if the same data base used for the logistic function were used in the discriminant function and the same "outside" landowner attributes were subsequently assessed, the discriminant function would classify the landowner as a "likely" PFA client. The discriminant function has been more widely used in forestry. Its applications have included classification of landowners into commercial forest management classes, both in eastern Oklahoma and southeastern Missouri.

* A copy of "Evaluating Nonindustrial Private Landowners for Forestry Assistance Programs: A Logistic Regression Approach" is located in the appendix.

The Field Windbreak:

Perceptions of Agricultural Producers and Professionals in Eastern Nebraska[1/]

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Department of Forestry Fisheries and Wildlife
University of Nebraska - Lincoln
Lincoln, Nebraska

Introduction

In September 1982, as part of a study of the economics of field windbreaks, a survey was conducted of a random sample of 2,500 agricultural producers in eastern Nebraska. The study area covered approximately the eastern third of Nebraska, and included three entire Crop and Livestock Reporting Districts (figure 1). A total of 41 counties were involved. The purpose of the survey was to determine producers' perceptions regarding field windbreaks, as well as to inventory some of the existing field windbreaks, and to clarify the reasons for windbreak removals and establishments since 1972. A 22 percent response rate was achieved.

In conjunction with the survey of agricultural producers, a second mail survey was conducted in the professional community most likely to advise agricultural producers and landowners about field windbreaks; i.e., the Soil Conservation Service District Conservationist and the County Extension Agent. The purpose of the second survey was to determine what, if any, differences exist between the perceptions of the producers and the professionals, and to identify areas where more education and information may be needed.

The professional survey was mailed in early 1983 to all applicable County Extension Agents and District Conservationists within the same area covered by the producer survey. Seventy-five questionnaires were mailed, 40 to County Agents, and 35 to District Conservationists (one County Agent was serving two counties in the study area). An 84 percent response rate was achieved, with 80 percent of the County Agents, and 89 percent for SCS personnel cooperating. Given that the response involved nearly the entire population, we believe we have an accurate indication of the perceptions of the professional community regarding field windbreaks.

1/ Work supported by the Departments of Agricultural Economics, and Forestry, Fisheries and Wildlife, UN-L and the Nebraska Forest Service.

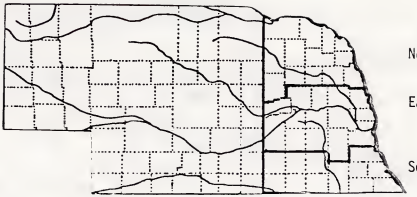

Figure 1. Study Area

THE FINDINGS

THE PRODUCER VS. PROFESSIONAL PERCEPTIONS

In general, both agricultural producers and professionals had positive perceptions of field windbreaks in relation to production agriculture. For example, more than nine out of ten producers and nearly all of the professionals responding considered field windbreaks to have at least some value as a conservation practice (Table 1). Moreover, the majority of both groups believed that windbreaks yield at least some additional economic returns--apparently due to crop yield increases on protected land. Also, a majority of those responding felt that field windbreaks are an asset that increases the value of farmland. Likewise, most had a desire to see more field windbreaks in their county in the coming years. The concept, at least, of field windbreaks appears to be favorably perceived by most individuals.

A closer look at the survey results, however, reveals interesting differences and hopefully a better understanding of public attitudes and beliefs regarding field windbreaks. Several aspects merit particular attention, including reasons for windbreak establishment and removal, row numbers, and the question of best land use.

As shown in table 2, a wide range of reasons exist for establishment of field windbreaks. However, for both survey respondent groups, soil conservation and cattle protection for winter grazing--historically the most common uses for field windbreaks--were the two most important primary reasons, followed by snow management. Interestingly, a very low incidence of respondents indicated that crop yield improvement was a primary reason for windbreak establishment. From this, one might infer that economic considerations do not enter into windbreak establishment decisions from a direct crop production standpoint.

TABLE 1. GENERAL PERCEPTIONS OF THE VALUE OF FIELD WINDBREAKS BY AGRICULTURAL PRODUCERS AND THEIR PROFESSIONAL ADVISORS IN EASTERN NEBRASKA, 1982

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP PROFESSIONALS	PRODUCERS
	-- percent distribution --	
A. How do you perceive the value of field windbreaks as a conservation practice?		
Definite value	58.7	50.8
Some value	39.7	42.2
No value	1.6	7.0
	100.0%	100.0%
B. How do you perceive the presence of mature field windbreaks on farmland values?		
Sizable increase in value	9.5	14.7
Some increase in value	49.2	49.7
No effect on value	33.3	23.4
Negative effect on value	7.9	12.2
	100.0%	100.0%
C. How do you perceive the effect of mature field windbreaks on crop production yields in fields protected by windbreaks?		
Sizable yield increase	9.5	10.9
Some yield increase	61.9	52.4
No yield effect	19.0	21.2
Some yield decrease	7.9	14.2
Sizable yield decrease	0.0	1.3
	100.0%	100.0%
D. Given your comments above concerning yield effects as well as consideration of farmland taken out of production by the presence of windbreaks, how do you perceive the net economic effect of establishing field windbreaks to protect cropland?		
Sizable economic returns	11.1	8.3
Some additional returns	47.6	53.3
No effect on ecomonic returns	30.2	19.9
Some economic loss	9.5	17.5
Sizable economic loss	0.0	1.0
	100.0%	100.0%

TABLE 2. VARIOUS OPINIONS OF AGRICULTURAL PRODUCERS AND THEIR PROFESSIONAL ADVISORS REGARDING FIELD WINDBREAKS, EASTERN NEBRASKA, 1982

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP PROFESSIONALS	PRODUCERS
	-- percent distribution --	
1. In your opinion, what are the reasons for field windbreak removals in your area? Please check one primary reason.		
Age and Condition of windbreak	11.1	21.4
Preparation for new windbreak	0.0	2.4
Windbreak competing with crops	6.3	7.1
Conflict with farming practices	28.6	16.7
No economic value of land in windbreak	15.9	2.4
Conflict with irrigation development	25.4	42.9
Caused excessive snow accumulation on roads	0.0	2.4
Right-of-way expansion for road	0.0	0.0
Consolidation of added on fields	4.8	4.8
Other. Please specify	7.9	0.0
	100.0%	100.0%
2. What do you feel are the most important reasons for field windbreak establishment in you area? Please check one primary reason.		
Crop yield improvement	7.0	6.3
Soil conservation (erosion control)	22.8	37.5
Aesthetic (appearance) considerations	8.8	6.3
Cattle protection during winter grazing	28.1	31.3
Increased value of the property	1.8	0.0
Snow management	17.5	12.5
Provide wildlife habitat	3.5	6.3
Trees to be used for firewood, posts, etc.	4.8	6.3
Other. Please specify	3.2	0.0
	100.0%	100.0%
3. How many rows of trees do you think are necessary in a field windbreak for it to be effective?		
	-- Average No. --	
Mean number of rows	2.24	3.29

TABLE 2. VARIOUS OPINIONS OF AGRICULTURAL PRODUCERS AND THEIR PROFESSIONAL (Cont.) ADVISORS REGARDING FIELD WINDBREAKS, EASTERN NEBRASKA, 1982

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP PROFESSIONALS	PRODUCERS
3a. Distribution of rows necessary for a field windbreak to be effective.		
	-- rows --	-- frequency --
	1	22	50
	2	20	94
	3	12	113
	4	3	79
	5	5	41
	6	1	28
	7		4
	8		8
	10		2
		-- percent distribution --	
4. Are you aware of any economic incentive programs which encourage landowners to establish field windbreaks		
Yes	82.5	42.9
No	17.5	57.1
	100.0%	100.0%
5. In your area, do field windbreaks currently standing represent the best use for the land area occupied?		
Yes	36.6	70.9
No	15.0	10.2
Not sure	48.3	18.9
	100.0%	100.0%
6. Do you have a desire to see more field windbreaks being established in your county in the coming year?		
Yes	71.4	50.2
No	9.5	13.2
Indifferent	19.1	36.5
	100.0%	100.0%

As for primary reasons for windbreak removal, conflict with irrigation development was the most frequent answer given among agricultural producers. More than four out of ten reported this reason. The professionals also noted this reason frequently. Conflict with farming practices was also a frequent response in both surveys. Obviously, changing technology and cultural practices foster necessary adjustments in land use, and this often includes tree removal.

Inevitably, field windbreaks must be removed and/or replaced as their useful life ends. Age and condition of the windbreak was a factor cited by many of the agricultural producers as the primary reason for windbreak removal. But, it also stands to reason that the declining effectiveness of a windbreak as well as aesthetic considerations due to its age and condition may be indirectly involved in many of the decisions involving farm technology and cultural practices.

While generally the opinions and perceptions of agricultural producers were constant with those of the professional groups, some notable differences did exist. Most notable were (1) the differences in the number of rows perceived as necessary for field windbreak to be effective; (2) best use of the land area occupied by the windbreak; (3) awareness of economic incentive programs which encourage windbreak establishment; (4) the desire to see more field windbreaks in the future.

Producers, on the average, believed that 3 rows of trees were necessary for a windbreak to be effective. In contrast, professionals, on the average, were inclined to believe that two rows will make an effective windbreak. This difference could be a major factor in the decision of a producer considering the establishment of a windbreak. The extra row that the producer feels is necessary translates into an extra two acres per mile (assume 16 feet as the effective width of a row of trees in a windbreak). This additional width could have major implications in how a producer perceives the economics of a field windbreak.

The question regarding whether the land occupied by a field windbreak is in its best use, was asked to only those producers who had one or more field windbreaks within their farming system. Nearly 71 percent of those responding feel that the land occupied by the windbreak was in its best use. In short, a majority of producers with a field windbreak were satisfied with that arrangement. This compares to only 37 percent of the professionals who felt that the field windbreaks in their area represent the best use of the land occupied, while nearly half of that group reported uncertainty. The high level of uncertainty to this question by professionals could be a reflection of the wide range of quality and/or design differences among windbreaks in their respective areas.

A rather marked contrast occurs in the awareness of economic incentive programs designed to encourage the establishment of field windbreaks. While it is expected that a larger percentage of professionals would have knowledge of these programs, it is disappointing that a majority of the producers are unaware of even one program designed to encourage the establishment of field windbreaks. This appears to be an area where greater emphasis on the education of landowners regarding available programs would be helpful.

A final difference of note is the question regarding the desire to see more field windbreaks in the future. Seventy-one percent of the professionals responded affirmatively, compared to only 50 percent of the producers. Apparently, agricultural producers responded to this question moore pragmatically than the professional group; that is, the producers appeared to be more cognizant of the associated costs than the professional group. This was further evident by the fact that only 18 percent of the producers reported that they plan to establish windbreaks or encourage their landlords to do so within the next 5 to 10 years.

Specific Findings Pertaining to the Professional Group

The professional survey, although favorable, reveals a couple of areas of concern. One such area is in regard to the availability of incentive programs to encourage the establishment of windbreaks. Eighty-three percent of the professionals indicated an awareness of such incentives. Yet 17 percent, more than one professional in six, was unaware of any programs available in his or her area to encourage the establishment of field windbreaks.

Table 3 presents a breakdown of the professional survey by organization. The most notable portion of the survey concerns office contacts, questions 1 and 2. While the frequency of contacts is not substantially different, the adequacy of available information for fielding questions regarding windbreaks is considerably different. SCS personnel appear to be more likely to have adequate or usually adequate information than the County Agent. This was expected since one of the missions of the SCS is the establishment of windbreaks. However, for nearly half of the County Agents, the available information about field windbreaks was reported inadequate or needed updating.

The level of awareness of the professional with respect to incentive programs designed to encourage the establishment of field windbreaks is encouraging[1/]. Among the SCS personnel, 90 percent report that they are aware of at least one incentive program. Seventy-five percent of the County Agents indicated a similar awareness. However, when specific incentive programs are considered, the differences suggest some areas of concern. Both groups were equally aware of various cost share programs.

1/ This has more important implications with respect to adoption of field windbreaks as a conservation practice. It has been demonstrated that field windbreaks are economical from a crop yield increase standpoint (Brandle et al, 1982); however, the initial costs of establishment are high, especially in terms of foregone production, and the benefits do not begin for a number of years. Incentive programs help offset the early costs and make investment in a field windbreak more attractive. The importance of these incentive programs in a landowner's decision whether of not to invest in a field windbreak cannot be understated.

TABLE 3. BREAKDOWN OF VARIOUS OPINIONS OF PROFESSIONAL REGARDING FIELD WINDBREAKS, EASTERN NEBRASKA, 1982.

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP: PROFESSIONAL TOTAL	COUNTY EXTENSION AGENTS	SCS
	-- percent distribution --		
1. How often, on the average do landowners contact your office in regards to field windbreaks?			
Less than once a month	60.3	59.4	63.3
Once of twice a month	20.6	21.9	20.0
3 to 5 times a month	12.7	15.6	10.0
More than 5 times a month	4.8	3.1	6.7
	100.0%	100.0%	100.0%
2. Do you feel that you have adequate informational materials available to answer landowner's questions regarding field windbreaks?			
Yes, definitely	25.4	6.3	45.2
Usually adequate	44.4	46.9	41.9
Could use updating	23.8	37.5	9.7
No	6.3	9.4	3.2
	100.0%	100.0%	100.0%
3. How do you perceive the value of windbreaks as a conservation practice?			
Definite value	58.7	53.1	64.5
Some value	39.7	43.8	35.5
No value	1.6	3.1	0.0
	100.0%	100.0%	100.0%
4. How do your perceive the presence of mature field windbreaks on farmland values?			
Sizable increase in value	9.5	9.4	9.7
Some increase in value	49.2	53.1	45.2
No effect on value	33.3	31.3	35.5
Negative effect on value	7.9	6.3	9.7
	100.0%	100.0%	100.0%

TABLE 3. BREAKDOWN OF VARIOUS OPINIONS OF PROFESSIONAL REGARDING FIELD (Cont.) WINDBREAKS, EASTERN NEBRASKA, 1982.

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP: PROFESSIONAL TOTAL	COUNTY EXTENSION AGENTS	SCS
	-- percent distribution --		
5. How do you perceive the effect of mature field windbreaks on crop production yields in fields protected by windbreaks?			
Sizable yield increase	9.5	6.5	12.9
Some yield increase	61.9	64.5	61.3
No yield effect	19.0	16.1	22.6
Some yield decrease	7.9	12.9	3.2
Sizable yield decrease	0.0	0.0	0.0
	100.0%	100.0%	100.0%
6. Given your comments above concerning yield effects as well as consideration of farmland taken out of production by the presence of windbreaks, how do you perceive the net economic effect of establishing field windbreaks to protect cropland?			
Sizable economic returns	11.1	9.4	13.3
Some additional returns	47.6	50.0	46.7
No effect on ecomonic returns	30.2	31.3	30.0
Some economic loss	9.5	9.4	10.0
Sizable economic loss	0.0	0.0	0.0
	100.0%	100.0%	100.0%
7. Are you aware of any economic incentive programs which encourage landowners to establish field windbreaks?			
Yes	82.5	75.0	90.3
No	17.5	25.0	9.7
	100.0%	100.0%	100.0%

TABLE 3. BREAKDOWN OF VARIOUS OPINIONS OF PROFESSIONAL REGARDING FIELD (Cont.) WINDBREAKS, EASTERN NEBRASKA, 1982.

QUESTION & RESPONSE	RESPONSE BY SURVEY GROUP: PROFESSIONAL TOTAL	COUNTY EXTENSION AGENTS	SCS
	-- percent distribution --		
7a. Please check the program(s) you are aware of in your area which are available to landowners.			
Technical assistance	73.0	65.6	80.6
Government cost-sharing for establishing field windbreaks	60.3	59.4	61.3
Leasing eligibility of windbreak acreage for wildlife habitat	49.2	28.1	71.0
I.R.S. tax provisions on tree establishment costs	20.6	21.9	19.4
Other. Please specify	6.3	6.3	6.5
	100.0%	100.0%	100.0%
	-- Average Number of Rows --		
8. How many rows of trees do you think are necessary in a field windbreak for it to be effective?			
Mean number of rows	2.24	2.69	1.77
Frequency distribution of rows			
-- rows --			
1	22	6	16
2	20	9	11
3	12	11	1
4	3	2	1
5	5	3	2
6	1	1	0

SCS personnel were slightly more aware of technical assistance, and much more aware of the various Nebraska Game and Parks habitat programs than the County Extension Agents. Of most concern was the lack of awareness by both groups of I.R.S. provisions on tree establishment costs. While it would be unwise for either of these groups to advise landowners on tax matters, it is important that they be aware of the existence of tax benefits, and that they recommend that the landowner consult his tax advisor when considering the establishment of a windbreak.

The last area of difference concerns the number of rows necessary for a windbreak to be effective. Sixteen of the 31 SCS respondents indicated that only one row is necessary. In contrast, 11 out of 32 County Agents felt three rows are necessary. Again, these extra rows and the land they occupy influence the size of the economic returns and as a consequence, the perception of the economic value of field windbreaks.

PATTERNS OF SURVEY RESPONSE BY CROP REPORTING DISTRICT

The final section of this paper deals with how the responses to the survey vary with geographical location. A great deal of change in the physical geography of the study area occurs from north to south. Average annual precipitation drops ten inches, moving from the southeast to northwest (Elder, 1969). Soil type is another consideration, as the northeastern crop reporting district includes a small portion of the Sandhills region. Changes in landscape also occur that may alter the perception of field windbreaks. The southern portion of the study area tends to be more dissected, making for a predominance of small, irregularly shaped fields. Historical differences between areas may also create differing perceptions of field windbreaks. The northeastern corner of the study area was included in the Great Plains Forestry Project, and many of the wide, multi-row windbreaks planted under that program still stand. The southern area had its first experience with windbreaks in the form of single row osage orange hedge rows, once used as a substitute for fencing, but notorious for their competition with crops for water and nutrients.

Tables four and five present a summary of the producer and professional surveys divided by crop reporting district. A definite pattern occurs in the responses as one moves from north to south. For example, the distribution of primary removal reasons (Table 4) given by the agricultural producers changes a great deal moving south across crop reporting district boundaries. Conflict with irrigation development is a greater factor in the removal of windbreaks in the northeast compared to the southeast; however, conflict with farming practices is much more important in the southeast. One could infer that changes in irrigation technology in the northeast and changing cultural practices in the southeast play the major roles, respectively in the removal of field windbreaks. Interestingly, competition with crops is only given as a major reason for windbreak removals in the southeast district, possibly due to the competitiveness of the osage orange hedge rows. Also of note is the high percentage of producers in the east central region who reported age and condition as the primary removal reason. The professionals, in contrast, did not seem to vary a great deal between crop reporting district on this question.

Due to a small number of producers responding to the reasons for field windbreak establishment, little can be said about this group in regard to this question. Again, the professional response does not vary a great deal across district boundaries.

The number of rows necessary also followed the same pattern. Producers in the northern area believed more rows are necessary than elsewhere, while professionals were generally more consistent in their views across the study region.

The value of field windbreaks as a conservation practice (table 5) is an area where both producers and professionals followed the same pattern. A majority of the professionals and the producers in the northeast district believe that field windbreaks are a definite value as a conservation practice. The percentage of those in each group sharing this view declined as one moves south through the study area. A possible explanation for this is the relative damage caused by wind erosion in the three districts. Wind erosion becomes a lesser problem as one moves south through the area.

The rest of table five follows a similar pattern. The producers in the northeastern crop reporting district generally have a more favorable perception of field windbreaks than their counterparts in the southeastern district. This pattern was also visible in the professionals, but not to the same extent. In short, the professionals did not tend to differ as much as producers with respect to location.

TABLE 4. VARIOUS OPINIONS OF AGRICULTURAL PRODUCERS AND THEIR PROFESSIONAL ADVISORS REGARDING FIELD WINDBREAKS, BY CROP AND LIVESTOCK REPORTING DISTRICT, 1982.

QUESTION & RESPONSE	-- CROP REPORTING DISTRICT -- NORTHEAST		EAST CENTRAL		SOUTHEAST	
	pro.	farm	pro.	farm	pro.	farm
1. In your opinion, what are the reasons for field windbreak removals in your area? Please check one primary reason.	-- percent distribution --					
Age and condition of windbreak	11.1	21.7	13.0	42.8	9.1	8.3
Preparation for new windbreak	0.0	0.0	0.0	0.0	0.0	8.3
Windbreak competing with crops	0.0	0.0	0.0	0.0	18.2	25.0
Conflict with farming practices	38.9	8.7	26.1	14.3	22.7	33.3
No economic value of land in windbreak	16.7	0.0	17.4	14.3	13.6	0.0
Conflict with irrigation development	27.8	65.0	26.1	28.6	22.7	8.3
Caused excessive snow accumulation on roads	0.0	4.3	0.0	0.0	0.0	0.0
Right-of-way expansion for road	0.0	0.0	0.0	0.0	13.6	16.7
Consolidation of added on fields	0.0	0.0	0.0	0.0	0.0	0.0
Other. Please specify	5.6	0.0	17.4	0.0	0.0	0.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2. What do you feel are the most important reasons for field windbreak establishment in your area? Please check one primary reason.						
Crop yield improvement	11.1	0.0	0.0	0.0	11.1	25.0
Soil conservation (erosion control)	22.2	37.5	19.0	25.0	27.8	50.0
Aesthetic (appearance) considerations	5.6	12.5	14.3	0.0	5.6	0.0
Cattle protection during winter grazing	33.3	50.0	28.6	25.0	22.2	0.0
Increased value of the property	0.0	0.0	0.0	0.0	5.6	0.0
Snow management	16.7	0.0	19.0	25.0	22.2	25.0
Provide wildlife habitat	5.6	0.0	0.0	25.0	5.6	0.0
Trees to be used for firewood, posts, etc.	5.6	0.0	9.5	0.0	0.0	0.0
Other. Please specify	0.0	0.0	0.0	0.0	0.0	0.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

TABLE 5. GENERAL PERCEPTIONS OF THE VALUE OF FIELD WINDBREAKS BY AGRICULTURAL PRODUCERS AND THEIR PROFESSIONAL ADVISORS REGARDING FIELD WINDBREAKS, BY CROP AND LIVESTOCK REPORTING DISTRICT, 1982

QUESTION & RESPONSE	-- CROP REPORTING DISTRICT -- NORTHEAST		EAST CENTRAL		SOUTHEAST	
	pro.	farm	pro.	farm	pro.	farm
	-- percent distribution --					
1. How do you perceive the value of windbreaks as a conservation practice?						
Definite value	72.2	59.7	56.5	51.0	50.0	39.4
Some value	27.8	35.8	43.5	42.3	45.5	50.0
No value	0.0	4.4	0.0	6.6	4.5	10.6
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2. How do you perceive the presence of mature field windbreaks on farmland values?						
Sizable increase in value	11.1	16.5	8.7	17.8	9.1	8.4
Some increase in value	50.0	57.0	52.0	44.9	45.5	48.1
No effect on value	33.3	17.7	26.1	22.7	40.9	31.3
Negative effect on value	5.6	8.9	13.0	14.6	4.5	12.@
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3. How do you perceive the effect of mature field windbreaks on crop production yields in fields protected by windbreaks?						
Sizable yield increase	11.1	13.1	8.7	12.6	9.5	6.2
Some yield increase	72.2	58.8	52.2	50.0	66.7	47.7
No yield effect	11.1	17.6	21.7	22.0	23.8	24.6
Some yield decrease	5.6	10.5	17.4	13.7	0.0	19.2
Sizable yield decrease	0.0	0.0	0.0	1.6	0.0	2.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
4. How many rows do you think are necessary for a windbreak to be effective?						
Mean number of rows	2.1	3.3	2.5	3.5	2.1	2.8

TABLE 5. GENERAL PERCEPTIONS OF THE VALUE OF FIELD WINDBREAKS BY AGRICULTURAL (CONT') PRODUCERS AND THEIR PROFESSIONAL ADVISORS REGARDING FIELD WINDBREAKS, BY CROP AND LIVESTOCK REPORTING DISTRICT, 1982

QUESTION & RESPONSE	-- CROP REPORTING DISTRICT -- NORTHEAST		EAST CENTRAL		SOUTHEAST	
	pro.	farm	pro.	farm	pro.	farm
	-- percent distribution --					
5. How do you perceive the value of windbreaks as a conservation practice?						
Definite value	72.2	59.7	56.5	51.0	50.0	39.4
Some value	27.8	35.8	43.5	42.3	45.5	50.0
No value	0.0	4.4	0.0	6.6	4.5	10.6
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
7. How do you perceive the presence of mature field windbreaks on farmland values?						
Sizable increase in value	11.1	16.5	8.7	17.8	9.1	8.4
Some increase in value	50.0	57.0	52.0	44.9	45.5	48.1
No effect on value	33.3	17.7	26.1	22.7	40.9	31.3
Negative effect on value	5.6	8.9	13.0	14.6	4.5	12.2
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
8. How do you perceive the effect of mature field windbreaks on crop production yields in fields protected by windbreaks?						
Sizable yield increase	11.1	13.1	8.7	12.6	9.5	6.2
Some yield increase	72.2	58.8	52.2	50.0	66.7	47.7
No yield effect	11.1	17.6	21.7	22.0	23.8	24.6
Some yield decrease	5.6	10.5	17.4	13.7	0.0	19.2
Sizable yield decrease	0.0	0.0	0.0	1.6	0.0	2.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Conclusions

Although generally positive, a great deal of difference exists in the results of the two surveys conducted. The producer survey showed a level of perception regarding the value of field windbreaks higher than we had originally expected. The professional survey indicated some areas of disagreement between the two organizations surveyed. It also identifies some areas of concern, notably, the adequacy of information on field windbreaks, the awareness of available incentive programs, and the number of rows necessary for a field windbreak to be effective.

The professional survey also pointed out some areas where additional information is needed. If producers are going to be convinced to establish more field windbreaks in the future, the professionals with whom they deal must be better informed regarding crop yield improvements and the economic benefits associated with field windbreaks.

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Influence of Irrigation and Type of Transplants on the Establishment of Ponderosa Pine

By: John G. Scheetz

This study is designed to help implement the Montana Interagency Tree or Shrub Improvement Study (MITOSIS), Project Three--Improved Techniques of Establishing Coniferous Species in Windbreaks. This information will also be useful in reclamation of mined lands.

Conifers are superior material for use in windbreak and shelterbelt plantings because they are long-lived and provide year-long protection and color to the landscape. However, in early years winter desiccation significantly reduced survival. It is believed that by encouraging plants to quickly root as deeply as possible, this problem can be reduced.

A similar study was conducted at the Bridger PMC in 1976-1978 with Colorado blue spruce. It was found that the survival of potted plants was significantly better than the survival of bareroot plants. The various irrigation treatments had no significant effect on survival of either the bareroot or potted transplants.

Methods and Materials

Containerized and bareroot ponderosa pine Pinus ponderosa were received from the Montana Department of Natural Resources and Conservation Division of Forestry Nursery, Missoula, Montana.

All plants were transplanted into Field 4 at the Bridger PMC on May 17, 1979. Each treatment is replicated four times in a randomized, complete block design. Each plot consists of ten plants. Row spacing and spacing within the row is four feet. Holes for the transplants were made with a tractor-mounted, post-hole digger. Care was taken during planting so that the roots were exposed to air for only a minimum amount of time.

The following irrigation treatments were applied in 1979. There was no irrigation in 1980.

1. Bareroot -- No irrigation
2. Containerized -- No irrigation
3. Bareroot -- Irrigated May 17
4. Containerized -- Irrigated May 17
5. Bareroot -- Irrigated May 17 and August 16
6. Containerized -- Irrigated May 17 and August 16
7. Bareroot -- Irrigated May 17, August 16, and September 18
8. Containerized -- Irrigated May 17, August 16 and September 18
9. Bareroot -- Irrigated weekly from May 17 to October 4
10. Containerized -- Irrigated weekly from May 17 to October 4

Percent survival notes were recorded on October 9, 1979, and November 6, 1980. The plots were kept weed-free during both seasons.

TABLE 1. Project VI. Cultural Trials. Percent survival of bareroot and containerized transplants of ponderosa pine with various irrigation treatments applied in 1979 at the Bridger PMC. Planted May 17, 1979.

TREATMENT	1979 Percent Survival	1980 Percent Survival
Containerized -- 3 Irrigations	85.0 a[1/]	72.5 a[2/]
Containerized -- Irrigated weekly	77.5 a	57.5 a
Containerized -- 2 Irrigations	75.0 a	72.5 a
Containerized -- 1 Irrigation	75.0 a	72.5 a
Containerized -- No irrigation	75.0 a	65.0 a
Bareroot -- 2 Irrigations	30.0 b	17.5 b
Bareroot -- Irrigated weekly	22.5 bc	17.5 b
Bareroot -- 3 Irrigations	15.0 bc	12.5 b
Bareroot -- 1 Irrigation	15.0 bc	12.5 b
Bareroot -- No Irrigation	2.5 c	0 b

1/ Duncan's Multiple Range Test @ P=.05; CV=25.37%.
2/ Duncan's Multiple Range Test @ P=.05; CV=31.55.

APPENDIX TABLE 1. Project VI. Cultural Trials. Influence of Irrigation and Type of Transplants on the Establishment of Ponderosa Pine. Percent survival in 1980 of bareroot and containerized transplants of ponderosa pine grown under five irrigation treatments applied in 1979. Planted at the Bridger PMC on May 17, 1979.

Treatment	Replications I	II	III	IV
	%	%	%	%
Bareroot -- No irrigation	0	0	0	0
Containerized -- No irrigation	60	80	50	70
Bareroot -- Irrigated May 17, 1979	0	20	10	
Containerized -- Irrigated May 17, 1979	100	80	60	50
Bareroot -- Irrigated May 17 and August 16, 1979	20	10	20	20
Containerized -- Irrigated May 17 and August 16, 1979	70	20	70	90
Bareroot -- Irrigated May 17, August 16, & September 18, 1979	10	20	10	10
Containerized -- Irrigated May 17, August 16 & September 18, 1979	100	90	60	40
Bareroot -- Irrigated weekly, May 17 through October 4, 1979	10	10	30	20
Containerized -- Irrigated weekly, May 17 through October 4, 1979	80	30	80	40

PERCENT SURVIVAL OF BAREROOT VS. CONTAINERIZED
PONDEROSA PINE TRANSPLANTS OF VARIOUS MONTANA LOCATIONS

PLANTING YEAR	MONTANA LOCATION	NUMBER PLANTED		NUMBER ALIVE 1982		1982 SURVIVAL %		1982 HEIGHT (ft)	
1979	Wibaux	83	--	0	--	0	--	--	--
1980	Big Sandy	40	31	27	29	68	94	1.00	1.00
	Culbertson	20	20	0	11	0	55	--	.33
	Decker	20	20	2	2	10	10	0.5	0.5
	Shelby	50	50	0	0	0	0	--	--
	Scobey	25	22	0	6	0	27	--	1.00
	White Sulphur Springs	20	20	8	10	40	50	1.00	1.20
	Whitehall	10	10	5	4	50	40	0.7	0.50
1981	Big Sandy	6	6	5	5	83	83		
	Choteau	35	35	4	35	11	100	1.00	1.00
	Conrad	25	25	15	20	60	80	1.00	1.00
	Ekalaka	100	100	0	0	0	0	--	--
	Havre	50	50	22	18	44	36	1.00	1.00
	Terry	30	30	24	25	80	83	1.00	1.00
	TOTAL	514	419	112	165				
	AVERAGE					44.6	65.8	.9	.85

Results

At planting time, the quality of the bareroot plants appeared superior to the containerized plants.

After 2 years, the type of transplant--bareroot or containerized--had more effect on the survival of ponderosa pine than the various irrigation treatments (table 1). The containerized transplants had significantly better survival, regardless of irrigation treatment, than the bareroot transplants. The various irrigation treatments had no effect on the survival of either the containerized or bareroot transplants after 2 years.

The second-year results of this study compare quite well with the second-year results of a similar study with Colorado blue spruce. The potted Colorado blue spruce had 57 percent survival compared to 68 percent for the containerized ponderosa pine. Both the bareroot spruce and bareroot ponderosa pine had a survival of 12 percent.

Effects of Irrigation on the Establishment of Woody Species

By: John G. Scheetz
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Surface mining of coal and other minerals with related surface disturbances has created substantial acreages where woody species are needed for revegetation.

The purpose of this study is to determine the effect of various irrigation treatments on the establishment and growth of bareroot versus potted plants of Colorado blue spruce.

Methods and Materials

Bareroot and potted plants of Colorado blue spruce were purchased from Plumfield Nurseries, Inc., Fremont, Nebraska. The plants were 12-15 inches tall. They were hand planted in Field H at the Bridger PMC on May 12, 1976. Care was taken during planting so that the roots were exposed to air for only a minimum amount of time. The plot layout is a four-replication, split-plot design with irrigation treatments as main plots and type of root stock as subplots. Each subplot consists of 12 plants.

The irrigation treatments were:

1. No irrigation.
2. Irrigation at Planting - May 12, 1976.
3. Irrigation at planting plus one additional irrigation--May 12 and July 13, 1976.
4. Irrigation at planting plus two additional irrigations--May 12, July 13, and September 9, 1976.

Each plant received one 3-pound coffee can (3 quarts) of water for each irrigation. No additional irrigation water will be applied through the remainder of the study.

The original height of each plant was measured. The growth of each surviving plant since May 1976 was measured in November 1978.

The planting was weeded periodically throughout the 1978 growing season.

Results

Growth was not affected by either the irrigation treatments applied in 1976 or by the type of transplants (bareroot or potted) in either 1976 or 1977. Growth was not determined in 1978.

The various irrigation treatments had no significant effect on survival of either the bareroot or potted transplants any of the 3 years (table 1). The survival of potted plants was significantly better all 3 years than the survival of bareroot plants. Survival of the potted plants dropped from 95.3% in 1976 to 42.75% in 1978. Survival of the bareroot plants dropped from 19.3% in 1976 to 7.3% in 1978.

This study should be planted again to compare results of different years.

TABLE 1. Project VI. Cultural Trials. Percent survival of bareroot and potted transplants of Colorado blue spruce under four irrigation treatments applied in 1976 at the Bridger PMC--1978. Planted May 12, 1976.

Type Root Stock	Irrigation Treatment 1	2	3	4	1978 Average	1977 Average	1976 Average
	%	%	%	%	%	%	%
Potted	56.5	31.25	35.5	47.75	42.75 a 1/	56.7 a 1/	95.3 a 1/
Bareroot	4.25	6.25	6.25	12.5	7.3 b	12.0 b	19.3 b
Average	30.4	18.75	20.9	30.1	25.0	34.3	57.3

1/ Duncan's Multiple Range Test @ P=.05.

PRINCIPLES OF CONSULTATION

I. Introduction

The complexities of large business organizations require that the effective manager play many roles. In addition to the role of decision-maker, planner, leader, evaluator, etc., an important requirement of effective managerial behavior is that the manager be able to function as an advisor, consultant, coach, or helper in dealing with problems of subordinates, peers, and superiors. These functions can be summarized as those of a consultant. Thus, when performing as an advisor to his superior, when helping on strategy planning and problem-solving with a coordinate level manager, and when serving as a teacher or coach with subordinates in their problem-solving and development, the manager fulfills the consulting role.

Traditionally, the consultative functions are more likely to be attributed to staff specialists, since their job definition emphasizes being available for help to the line organization. Today, however, it is clear that the line manager has consulting responsibilities as well. In fact, detailed observation of managers in operation indicates that a good portion of their time is spent in the same kinds of behaviors as staff people.

Moreover, a manager who provides advice at one moment is very likely to be in the position of seeking or accepting advice at another time. This rhythm of giving and receiving help points up clearly the termendous interdependence that exists today within the management ranks of a large organization. With empahsis upon hardhitting, competitive approaches and "survival of the fittest", the need for giving and receiving help must be met if a managerial group is to be welded together into a cohesive, effective organization.

II. Managerial Attitudes Toward the Consulting Role

All managers accept the fact that their job is to obtain results through people. For most managers, this statement is defined primarily in terms of motivating, leading, controlling, and directing. It is only when a serious difficulty arises with a subordinate or coordinate level manager whose performance is not sufficient to meet the objectives established that a manager begins to see himself as being a helper or advisor. But if managers could accept continuing responsibility for consultation, they could initiate preventive action and help people improve their performance before they faced a crisis or emergency situation.

Analysis of the attitudes of managers toward giving and receiving help indicates that there are some barriers which stand in the way of both asking and receiving consultative help. The more important of these are as follows:

A. Barriers to Giving Help

1. Emphasis upon rugged individualism and standing on one's own feet.
2. Not understanding what another person needs by way of help.
3. Assuming a lack of skill to help the other person.

4. Unwillingness to risk not having own ideas accepted.

5. Belief that helping others will make them dependent and use you as a crutch.

6. Not wanting to become involved in a difficult or touchy problem.

B. Barriers to Asking for Help

1. Fear of looking stupid or weak.

2. May hear what you don't want to hear, e.g., criticism.

3. May have to raise an unpopular subject.

4. Lack of confidence that consultation can be useful.

5. Belief in doing everything yourself.

Not all of these barriers exist in the attitudes of all managers, but in order to be effective in a consulting role, it is necessary for a manager to analyze his own outlook and to understand what factors may be inhibiting or facilitating his usefulness as an advisor.

III. What Does a Person Asking for Assistance Want from his Helper?

The consulting role becomes much clearer by analyzing just what a person seeking assistance wants. Obviously, in some way the seeker (client) wants a solution to the problem he presents to his helper (advisor). However, it is often very clear that the client has thought of most of the solutions to the problem but somehow cannot bring himself to accept one of the alternatives and to make the decision which would result in action. If many or most of the solutions are already known to the person seeking advice, then a consultant who lays down a barrage of suggestions and advice to a client may be trying to "put water into a pail that is already full." Ofter something else is desired by a person seeking advice.

What the client usually wants is a combination of such things as an opportunity to ventilate his thoughts and feelings, to have a mirror or sounding board which he can use to clarify the problem and his approach to it, and some reassurance that the helper understands his situation. Sympathetic acceptance of the problem and the person presenting it may be more helpful than an idea. Most managers prefer to develop their own ideas. What the client frequently needs is to hear how his possible course(s) of action sound to his own ears, and to feel emotionally secure about the fruits of his reasoning.

IV. Consultant Needs and Satisfactions.

It is important for the consultant to get some significant rewards from the relationship and to satisfy some needs of his own. While a consultant holds his own needs temporarily in abeyance when he is trying to help his client, most consultants hope to learn something from being involved in this relationship which can be useful to them later. This includes gaining information about the experience of another person which helps to broaden

the consultant's perspective. Secondly, the consultant likes the ego-satisfaction of having been sought out as an advisor, and of being trusted enough by the client to be taken into the problem and involved in the situation. The consultant hopes to have his ideas and suggestions accepted but, in the final analysis, success in helping the client gain new insights should provide more satisfaction than whether a given proposal of the consultant is finally accepted.

A third source of satisfaction for the consultant is the knoweldge that he has shared in the ultimate results. Knowing that he has been a part of the attack upon the problem, the consultant derives a sense of pleasure that comes from having participated in the solution of a difficult problem. This is, of course, the type of satisfaction that accrues from training or developing subordinates. Finally, the consultant gains a great deal of understanding about his client in the course of working together. When asking for help a manager's feelings, attitudes, wisdom, etc., are revealed in a much more complete way than would normally be possible in the busy pace of the work day. And this knowledge can be extremely useful to the helper in his other relationships with the person being helped, particularly in the mutual trust and respect that is developed.

V. Principles of Consultation.

1. The consultant constantly works toward a cooperative, mutually trusting relationship with his client. He is careful not to be critical nor excessively complimentary, yet he must be sincere in what he says. He aims toward increasing the client's trust in him so that the client feels free to communicate his problems, difficulties and concerns to the consultant. Furthermore, the consultant strives to create a relationship of joint responsibility for problem-solving rather than one of dependency upon the consultant's own knowledge and skills. Finally, the consultant must show himself worthy of the trust shown by the client by preserving the confidentiality of the material that is communicated to him.

2. The consultant strives to increase the independence and skill of the client. He hopes that his effort will result not only in solving specific problems presented but also in aiding the client's own growth and development over the long run. In this way, the client becomes more able to deal with problems on his own and develops self-confidence which will enable him to get by with less reliance upon consultative assistance. We might say that the consultant's effort is to help people learn how to solve problems, rather than to solve problems for them.

3. An important function of the consultant is to help the client diagnose the problem. While consultants are presented the problem by the client in the way the client sees it, consultative work frequently brings to light the fact that the real problem is different from the one brought by the client originally. In this respect, the consultant serves as a catalytic agent who can challenge assumptions, present alternatives and get the client to examine his attitudes and insights about the matter presented.

4. The consultant serves as a sounding board. Some consultants believe that they are not doing an effective job unless they are making suggestions or giving ideas. Often, however, a consultant is extremely useful because of his ability to listen and to help clarify the client's goals and

attitudes. The consultant believes that the client usually has resources to solve his own problems if they are sufficiently understood by him. As a sounding board, the consultant can be used to test ideas regarding innovation and change. From his broader perspective and experience, he may be able to help his client to forecast consequences of various lines of action more accurately.

5. The consultant makes suggestions but is not a decision-maker. In making suggestions, the consultant raises them as possibilities. He is tentative rather than certain for he does not have to have things done his way. When he believes that incorrect decisions are being made, he raises questions about the possible consequences of the decisions. Often the best thing that a consultant can do is to help the client see alternatives and the consequences. This may provide the necessary reassurance to a client who has already thought of most of the solutions himself, but has not thought through all the consequences becasue of his anxiety.

6. The consultant is selective in making suggestions. The consultant may have many ideas about improving the way the client can function or about how a given problem can be solved. However, if he brings up too soon the recommendations which are the most difficult for the client to accept, he is likely to create resistance which diminishes his usefulness considerably. Thus, he may postpone making some suggestions until the client is able to use these and has the readiness to accept the implications of the proposed action.

7. The consultant maintains objectivity. It is difficult for a manager while serving as an advisor to eliminate his evaluations of a situation against his own experience and his skill in analyzing similar situations. At times, the client will want and can benefit from having the consultant's evaluation of the situation. For the most part, however, the consultant can be more useful to his client by refraining from making evaluations and by helping the client to evaluate the situation himself by going through an impartial and objective joint analysis. This serves to minimize dependency uon the helper and is one of the best ways of getting the client to develop his own analytical skills.

SELF-INVENTORY OF MOTIVATIONAL & COACHING SKILLS

The purpose of this inventory is to help you identify your own strengths as a motivational coach and your own needs for improvement. It contains a list of questions about your coaching skills and knowledge--topics covered in this course--on which you can rate yourself. As you make your self-ratings, keep in mind that this is strictly for your own review purposes and is yours to keep. We suggest you review this inventory in one month to check on your own improvement.

If some of the questions do not seem to apply to your present job, you may, of course, leave them blank, but answer as many as you can so that you will have a more complete self-appraisal.

For each question, circle the number on the scale that most accurately describes your present level of capability.

1. How effective are you at helping your subordinates solve problems that come up on the job?

   1 2 3 4 5 6 7
   not effective very effective

2. How effective are you at discussing with subordinates areas of performance in which they need to improve?

   1 2 3 4 5 6 7
   not effective very effective

3. How effective are you at getting subordinates to talk with you about job problems when they are hesitant or reluctant to do so?

   1 2 3 4 5 6 7
   not effective very effective

4. How confident are you in your present ability to work with subordinates about their weaknesses?

   1 2 3 4 5 6 7
   not confident very confident

5. How effective are you at communicating with your subordinates about the order of importance of their various duties?

   1 2 3 4 5 6 7
   not effective very effective

6. How effective are you at getting your subordinates to come to you for help in solving their problems on the job?

   1 2 3 4 5 6 7
   not effective very effective

7. How skillful are you at determining which problems involving subordinates are most in need of attention?

1	2	3	4	5	6	7
not skillful						very skillful

8. How skillful are you at helping subordinates finds the causes of their job-related problems?

1	2	3	4	5	6	7
not skillful						very skillful

9. How skillful are you at helping subordinates develop their own solutions to problems that arise on the job?

1	2	3	4	5	6	7
not skillful						very skillful

10. How skillful are you at helping subordinates reach decisions in situations in which they are uncertain?

1	2	3	4	5	6	7
not skillful						very skillful

11. How much emphasis do you place on encouraging subordinates to improve their own problem-solving and decision-making skills?

1	2	3	4	5	6	7
no emphasis						very much emphasis

12. To what extent are your decisions free from the biasing effects of age, sex, race, and personsl friendship?

1	2	3	4	5	6	7
not completely free						completely free

13. How skilful are you at stimulating employees to think for themselves?

1	2	3	4	5	6	7
not skillful						very skillful

14. To what extent do your subordinates see you as a help and support rather than as a critic?

1	2	3	4	5	6	7
not completely						completely

15. How skillful are you at encouraging subordinates to express their true feelings in your presence?

1	2	3	4	5	6	7
not skillful						very skillful

16. When a subordinate has a problem, how skillful are you at finding out the facts and background as your subordinate sees them?

1 2 3 4 5 6 7
not skillful very skillful

17. To what extent do your subordinates regard you as having a genuine interest in their own development and success?

1 2 3 4 5 6 7
not at all completely

18. How skillful are you at being firm and decisive when you need to be?

1 2 3 4 5 6 7
not skillful very skillful

19. How skillful are you at convincing or persuading subordinates, without resort to expressed or implied threats?

1 2 3 4 5 6 7
not skillful very skillful

20. How skillful are you at working cooperatively with subordinates to solve work problems?

1 2 3 4 5 6 7
not skillful very skillful

21. How skillful are you at helping subordinates with special problems such as excessive drinking, marital difficulties, or mental stress?

1 2 3 4 5 6 7
not skillful very skillful

22. How skillful are you at using constructive questions when coaching subordinates?

1 2 3 4 5 6 7
not skillful very skillful

23. How skillful are you at getting information from a subordinate who is evasive in answering questions?

1 2 3 4 5 6 7
not skillful very skillful

24. How carefully do you prepare for coaching interviews with your subordinates?

1 2 3 4 5 6 7
not carefully very carefully

25. How effective are you at setting specific goals for your subordinates?

1 2 3 4 5 6 7
not effective very effective

26. How effective are you at seeing that your subordinates' goals are up to date in terms of changes taking place in your organization?

1 2 3 4 5 6 7
not effective very effective

27. How skillful are you at determining when goals shoul be set by your subordinates, by you, or jointly by you and your subordiantes?

1 2 3 4 5 6 7
not skillful very skillful

28. How effective are you at helping your subordinates achieve their goals on schedule?

1 2 3 4 5 6 7
not effective very effective

29. How effective are you at getting strong and definite commitment from your subordinates?

1 2 3 4 5 6 7
not effective very effective

30. How skilled are you at criticizing subordinates?

1 2 3 4 5 6 7
not skilled very skilled

31. How skilled are you at giving support and encouragement along with criticism?

1 2 3 4 5 6 7
not skilled very skilled

32. How successful are you at preventing daily routine from crowding out time to coach your subordinates?

1 2 3 4 5 6 7
not successful very successful

33. How skillful are you at obtaining your own superior's cooperation and support in your coaching activities?

1 2 3 4 5 6 7
not skillful very skillful

34. How skillful are you at listening to subordinates?

1	2	3	4	5	6	7
not skillful				very skillful		

35. Considering everything, to what extent do your subordinates regard you as a "coach" rather than as a "boss"?

1	2	3	4	5	6	7
completely a boss				completely a coach		

A SELF-EVALUATION CHECK-LIST FOR DEALING WITH THE PUBLIC

A. ACTIONS, APPEARANCES, AND SERVICES:

1. Do the people in your organization who have frequent contacts with the public make a top-notch impression in the way they act and look?

   Check these points:

   - Are they proud of their agency and do they understand the purpose of their jobs in relation to the function of the agency?

   - Do they have confidence in their ability and in what they are saying and doing?

   - Do they know the functions of other offices and branches and related departments?

   - Do they dress appropriately and present a pleasing appearance?

   - Do they avoid creating a negative impression in the sight and hearing of the public? (Examples: Private conversations, drinking coffee on the job, reading newspapers at their desks, feet on the desk, loafing).

   - Do they exercise a high degree of courtesy?

   - How is their tone of voice? Is it always warm and friendly?

   - Are they truly interested in providing service?

2. Is there any way that you can improve your public reception area?

   Check for:

   - Convenience - Tastful decor - Cleanliness and orderliness

   - Comfort - Ease of location - Clear identification

3. How about your information service? Can the public easily obtain desired information?

4. Are your office hours compatible with the needs of the public? Have you considered an extension of these hours?

5. Is your office clearly listed in the telephone directory, Federal office directly, and other publications?

B. OFFICIAL POLICIES, REGULATIONS AND PROCEDURES:

1. Are the regulations and procedures within your unit and organization reasonable and do they make sense to the public?

2. Can you and the people with whom you work logically and ismply explain the rules to someone who must abide by them?

3. Apply the same test to yur policies -- Have you ever heard anyone in your organization say to a visitor, "Don't ask me why. It's just policy." or, "Don't blame me for that rule -- I just work here."

C. HANDLING COMPLAINTS:

1. What procedures do you have for handling the irate customer?

2. Are you and your fellow employees proficient in all of hte following:

- Getting the facts

- Creating a problem-solving atmosphere

- Listening attentively to a person's story

- Checking back to see what happened

- Understanding the difficult customer

- Convincing the customer that you will do your best

- Demonstrating that you really care

- Taking the lead in order to satisfy the customer's needs?

D. TELEPHONE COURTESY AND TECHNIQUES:

1. Is the picture of your unit or office that comes over the phone a good one?

Make an actual survey - Observe closely the telephone manners and techniques of the people in the unit or office in which you work for ten days, then complete the check-list attached to this evaluation form. Just be sure to include your own telephone manners in the survey!

E. CORRESPONDENCE:

1. The written word underlines much of your work. What kind of impression do your letters make? Here's a suggestion: Carefully analyze outgoing mail for ten days, using the check-list attached to this evaluation form. Again, be sure to include your own letters in the survey!

F. EMPHASIS GIVEN TO PUBLIC CONTACTS: (Specifically for the Office Manager or Agency Head)

1. How do you communicate to the people you supervise? What is your interest in achieving excellence in dealing with the public? (Examples: Orientation programs, handbooks, training sessions, directive.)

2. Is there a focal point within your office or organization where there is responsibility for improving relations with the public?

3. Are you constantly monitoring the flow of information from your office to the public -- and what steps are you taking to improve the quality of that information?

4. What attention do you give to the ability to meet and deal with the public in your new hires, promotions and in other personnel actions?

5. Finally, what steps are you taking that will identify adverse public attitudes and dissatisfaction with the way you do business with the public?

YOU MEET THE PUBLIC BY TELEPHONE

SELF TEST

For each of the following items place a check in the column which applies:

	Always	Usually	Rarely or Never
1. I answer telephone calls promptly (at the end of the first ring, if possible).			
2. I have a pad and and pencil ready for making notes.			
3. I use identifying phrases at the beginning of all calls, incoming and outgoing, giving my name and, as approprimate, my office.			
4. I speak directly into the telephone mouthpiece, not over or under it.			
5. I speak clearly and naturally, without mumbling or shouting.			
6. I end calls courteously with a definite indication that the conversation is finished.			
7. I hang up the telephone gently.			
8. When it is necessary to leave the line, I give the caller a choice of waiting or being called back.			
9. When leaving the line, I come back and explain waits if it takes longer than expected.			
10. I avoid transferring calls whenever possible. However, if I must transfer a call, I transfer it to the person who I know can satisfy the caller.			
11. Before transferring a call, I give complete information to the caller.			
12. I plan conversations in advance, keeping them brief and businesslike without sacrificing friendliness and courtesy.			
13. After dialing I allow time to answer. (About ten rings or a full minute).			
14. I apologize for getting a wrong number.			
15. When placing a call, I am ready to talk when the person called answers.			

	Always	Usually	Rarely or Never
16. If my conversation is likely to be lengthy, I ask if it is convenient to talk.			
17. I keep and use an up-to-date list of frequently called numbers.			
18. I return promptly all calls received in my absence.			
19. The tone of my voice reflects a reasonably pleasing personality.			
20. I try to remedy the lack of face-to-face contact by generous use of phrases such as "Thank you", "Please", "Would you mind?", "I'll be glad to."			
21. I use the names of the persons with whom I speak.			
22. I avoid trite expressions which might make my speech sound mechanical and stereotyped.			
23. I supply information willingly and don't force callers to pry it out of me.			
24. When I return to the line, I first attract the attention of the other person by some introductory remark such as, "I have that information now."			
25. I keep in mind that to the caller my voice may be the Government or my agency.			

TOTAL _____

To find your score: a. Total the number of checks in "Rarely or Never" column and multiply by 4. b. Total the number of checks in the "Usually" column and multiply by 2. c. Add the two sums. d. Deduct that figure from 100. This is your score. MY TELEPHONE SCORE IS: _____

A score of 80 would indicate reasonably good telephone service on your part... but continue to strive for 100 as an objective.

YOU MEET THE PUBLIC BY LETTER

SELF - TEST

Keep a copy of all the letters you and your people write for one week. Then devote an hour or two to rating them with this check-list. The results are bound to surprise you. Do this three times at one month intervals and you won't have to do it often again. You will be writing better letters every time.

To help you improve you writing, use the Letter Rating Guide below:

	YES	NO
1. Count off the first 100 words. Are 70 to 80 one-syllable words?	___	___
2. Are your sentences short? Average 15 words or so?	___	___
3. Does each sentence carry one thought and no more than one thought?	___	___
4. Have you eliminated "that" whenever possible without altering the sense?	___	___
5. Does your letter talk "you" to the reader instead of "I" or "We"?	___	___
6. Have you started your letter with the main point of information your reader wants?	___	___
7. Do you believe what you have written?	___	___
8. If you are asking the reader for action, is it clear just what he is to do?	___	___
9. Does your letter look right? Arranged properly, clean and neat?	___	___
10. Did you try to understand your reader when you wrote and does your letter answer his question?	___	___

If you can answer YES to all of these questions, you have written a good letter.

DEVELOPMENT QUIZ FOR MANAGERS

Choose the appropriate answer: (a) I do this well enough, (b) Needs improvement, but not now, (c) Needs improvement now.

1. Every employee who reports to me has a written position description and written work plans covering the most important goals I expect him to achieve during the next three months. _____

2. Whenever I assign work or review work plans, I make sure there is some challenging new work for each employees. _____

3. Every employee has one improvement goal; that is, one part of his work which will produce a bigger contribution to the organization. _____

4. I take pride in keeping each employee informed about the organization, the plans of the department, any changes in company thinking, and similar matters so that he can do his work intelligently. _____

5. I frequently ask employees to suggest goals for their work, give their reasons for suggesting them, and make plans for meeting them. _____

6. I encourage each employee to know who his customers are - that is, what individuals or groups receive his work - and whether they are satisfied with what they are getting from him or have suggestions for improving it. _____

7. I ask each employee to evaluate his work periodically and discuss with me how it could contribute more to the business and what would make it more satisfying to him. _____

8. I encourage employees to make a reasonable number of innovations, to experiment, to find better work methods. _____

9. I have systems or machinery which encourages employees to air any disagreements they may have about technical or administrative matters, along with their reasons. _____

10. I do everything I can to thank those who bring me bad news early and to receive it constructively; that is, to focus on correcting the situation. _____

11. In filling open jobs, I consider the candidates' longer-range development needs and their potential value to the firm along with their immediate qualifications. _____

12. When I make a recommendation for a merit increase, I consider the employee's successful development efforts, for the people reporting to him and for himself, as a major factor in my decision. _____

13. I have up-to-date information on how each employee hopes to build a career for himself. _____

14. I have a written appraisal of each employee's talents, areas of deficiency changing capabilities as observed during the past three years. _____

15. I have identified an "unknown" with each employee--that is, an area of work he has never tried, some field of knowledge he has not had the opportunity to practice--and I have encouraged him to take steps to fill the gap, insofar as doing so might be useful in advancing his career interests. _____

16. No employee, except one about to retire, has been on the same job longer than five years. _____

17. The manager to whom I report knows which employees I believe are promotable and what next jobs they are most likely to be able to fill competently and when. _____

18. No one in the organization is on a job for which he is unsuited. _____

19. I keep the work I'm doing and the work decisions I'm making visible to employees and often ask them for their thoughts and suggestions to help me do my job better. _____

20. All indications from attitude surveys, comments during meetings, and similar communications show the employees are aware that I expect them to use their abilities fully and develop them as rapidly as possible so that our overall contribution to the firm is continuously enlarged in specific ways. _____

When you have chosen the letter you feel is right in each case, circle the three items which you have noted as needing improvement now and which you feel would have the highest immediate payoff for your organization. Build a short but specific action plan to improve in each area.

EVERY EMPLOYEE A MANAGER

This instrument is designed to help you better understand the assumptions you make about people and human nature. There are ten pairs of statements. Assign a weight from 0-10 to each statement to show the relative strength of your belief in the statements in each pair. The points assigned for each pair must in each case total ten. Be as honest with yourself as you can and resist the natural tendency to respond as you would "like to think things are." This instrument is not a "test". There are no right or wrong answers. It is designed to be a stimulus for personal reflection and discussion.

1. It's only human nature for people to do as little work as they can get away with. _____(a)

   When people avoid work, it's usually because their work has been deprived of its meaning. _____(b)
   10

2. If employees have access to any information they want, they tend to have better attitudes and behave more responsibly. _____(c)

   If employees have access to more information than they need to do their immediate tasks, they will usually misuse it. _____(d)
   10

3. One problem in asking for the ideas of employees is that their perspective is too limited for their suggestions to be of much practical value. _____(e)

   Asking employees for their ideas broadens their perspective and results in the development of useful suggestions. _____(f)
   10

4. If people don't use much imagination and ingenuity on the job, it's probably because relatively few people have much of either. _____(g)

   Most people are imaginative and creative but may not show it because of limitations imposed by supervision and the job. _____(h)
   10

5. People tend to raise their standards if they are accountable for their own behavior and for correcting their own mistakes. _____(i)

   People tend to lower their standards if they are not punished for their misbehavior and mistakes. _____(j)
   10

6. It's better to give people both good and bad news because most employees want the whole story, no matter how painful. _____(k)

   It's better to withhold unfavorable news about business because most employees really want to hear only the good news. _____(l)

   10

7. Because a supervisor is entitled to more respect than those below him in the organization, it weakens his prestige to admit that a subordinate was right and he was wrong. _____(m)

   Because people at all levels are entitled to equal respect, a supervisor's prestige is increased when he supports this principle by admitting that a subordinate was right and he was wrong. _____(n)

   10

8. If you give people enough money, they are less likely to be concerned with such intangibles as responsibility and recognition. _____(o)

   If you give people interesting and challenging work, they are less likely to complain about such things as pay and supplemental benefits. _____(p)

   10

9. If people are allowed to set their own goals and standards of performance, they ten to set them higher than the boss would. _____(q)

   If people are allowed to set their own goals and standards of performance, they tend to set them lower than the boss would. _____(r)

10. The more knowledge and freedom a person has regarding his job, the more controls are needed to keep him in line. _____(s)

    The more knowledge and freedom a person has regarding his job, the fewer controls are needed to insure satisfactory job performance. _____(t)

    10

Scoring

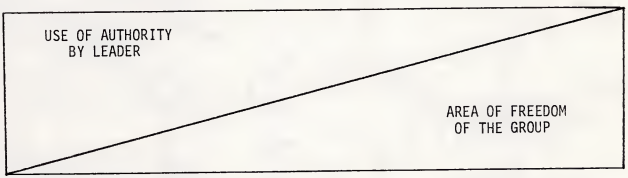
Theory X Score = Sum of (a), (d), (e), (g), (j), (l), (m), (o), (r), and (s).

Theory Y Score = Sum of (b), (c), (f), (h), (i), (k), (n), (p), (q), and (t).

Theory X Score	70 - 100	High
	31 - 69	Moderate
	0 - 30	Low
Theory Y Score	70 - 100	High
	31 - 69	Moderate
	0 - 30	Low

CONTINUUM OF MANAGEMENT BEHAVIOR

Leader Center ←----------→ Group Centered



Leader decides, announces decision	"Sells" decision to group	Announces decision, permits questions	Presents tentative decision, consults group and decides	Present problem, asks for ideas, decides	Presents problem and boundaries, group decides	Gives group as much freedom as he has to define problem and decide

Variables:

1. Interpersonal relations
2. Nature of the task
3. Unity of command
4. Environment

	THEORY X ASSUMPTIONS (traditional)	THEORY Y ASSUMPTIONS (emerging)
1.	People are natrually lazy; they prefer to do nothing.	People are naturally active; they set goals and enjoy striving.
2.	People work mostly for money and status rewards.	People seek many satisfactions in work: pride in achievement; enjoyment of process; sense of contribution; stimulation of new challenges, etc.
3.	The main force keeping people productive in thier work is fear of being demoted or fired.	The main force keeping people productive in their work is desire to achieve their personal and social goals.
4.	People remain children grown larger; they are naturally dependent on leaders.	People normally mature beyond childhood; they aspire to independence, self-fulfillment, responsibility.
5.	People expect and depend on direction from above; they do not want to think for themselves.	People close to the situation see and feel what is needed and are capable of self-direction.
6.	People need to be told, shown, and trained in proper methods of work.	People who understand and care about what theya re doing can devise and improve their own methods of doing work.
7.	People need supervisors who will watch them closely enough to be able to praise good work and reprimand errors.	People need a sense that they are respected as capable of assuming responsibility and self-correction.
8.	People have little concern beyond their immediate, material interests.	People seek to give meaning to their lives by identifying with nations, communities, churches, unions, companies, causes.
9.	People need specific instruction on what to do and how to do it; larger policy issues are none of their business.	People need ever-increasing understanding; they need to grasp the meaning of the activities in which they are engaged1; they have cognitive hunger as extensive as the universe.
10.	People appreciate being treated with courtesy.	People crase genuine respect from their fellow men.

	THEORY X ASSUMPTIONS (traditional)	THEORY Y ASSUMPTIONS (emerging)
11.	People are natrually compartmentalized; work demands are entirely different from liesure activities.	People are naturally integrated; when work and play are too sharply separated both deteriorate; "The only reason a wise man can give for preferring leisure to work is the better quality of the work he can do during leisure."
12.	People naturally resist change; they prefer to stay in the old ruts.	People naturally tire of monotonous routine and enjoy new experiences; in some degree everyone is creative.

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Evaluating Nonindustrial Private Landowners for Forestry Assistance Programs: A Logistic Regression Approach

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RESEARCH SUMMARY

As budgets in forest management agencies become more restrictive, cost-effective programs become more important. This paper describes a quantitative tool for setting priorities for the forestry assistance program administered by the Montana Division of Forestry. Logistic regression was used to better identify the type of forest owners to which assistance should be directed. (In logistic regression, the dependent variable is a probability that a certain event or activity will occur.) Data supporting model development were obtained from a questionnaire survey of forest landowners in the western portion of Montana. Four models were developed that pertain to past use of technical assistance, intention to harvest timber, and timber benefits as motivation for forest ownership. The most consistently useful independent variables were geographic region and past timber harvest activity. The author discusses procedures for interpreting results and for rating land ownerships for assistance. One model is discussed in detail, but the discussion is applicable to the other three models. Supporting data are presented for all models.

Evaluating Nonindustrial Private Landowners for Forestry Assistance Programs: A Logistic Regression Approach

Ervin G. Schuster

INTRODUCTION

Public programs providing technical forestry assistance to owners of nonindustrial forest land have become part of the forest economy in the United States. The Private Forestry Assistance (PFA) program administered by State Foresters (formerly known as the Cooperative Forest Management [CFM] program) along with extension forestry within the USDA Cooperative Extension Service, and to a lesser extent the State and Private Forestry division of the USDA Forest Service, provide the bulk of assistance. Assistance is ostensibly aimed at enabling the landowner to make informed decisions to accomplish personal objectives. Although the programs have multiple-use goals, the landowners' objectives usually favor timber growing, harvesting, and marketing. These programs, therefore, affect timber supply.

Recently, renewed interest in small, privately owned timber holdings coupled with static or declining assistance program budgets have compelled a closer look at the processes by which technical assistance is delivered to forest landowners. Increasingly, assistance must be delivered in a more cost-effective manner. Undersecretary of Agriculture John B. Crowell, Jr., recently spoke of the need to "improve the effectiveness of public programs aimed at encouraging more productive management of nonindustrial, private lands" (speech to the Forest Industries Committee on Timber Valuation and Taxation, Scottsdale, Ariz., November 4, 1982). Traditional programs will not meet that challenge.

Assistance programs would be improved if foresters could identify the landowners who will be most responsive to assistance. Better targeting of efforts and the rating of applicants would help. Given an appropriate data base, a logistic regression model is well suited to this need. This paper reports development of such models for western Montana and use by the Montana Division of Forestry, Department of State Lands. Although a few similar efforts can be found in Eastern States (see for examples Jones and Thompson 1981; Trokey 1981), none are known for the Intermountain West. The technique described in this paper, therefore, has the potential for widespread application.

METHODS

During the late 1970's, the Montana Division of Forestry and the USDA Forest Service undertook a cooperative study of the attitudes and activities of private landowners in Montana. A questionnaire was mailed to a stratified random sample drawn from the listing of forest landowners maintained by the Division of Forestry for use in its fire protection program. Responses from owners of less than 40 acres of forest land and from owners in eastern Montana were eliminated from the data base due to sampling problems. The final 41 percent response rate was explicitly analyzed for response bias; no statistically significant bias was found. Results were published in 1978 (Schuster 1978). The 499 completely usable responses from that study constitute the data base of this present study.

The Montana Division of Forestry requested that the Intermountain Forest and Range Experiment Station reanalyze data from the earlier study. The new objective was to develop information and relationships that would enable service foresters to better identify landowners that not only wanted and needed technical assistance, but who would also be likely to use or apply the assistance provided. Unfortunately, the latter question was not addressed in the original questionnaire.

Specific questions in the following categories were selected from that survey as the best indicators of landowner desire for and acceptance of technical assistance:

- Landowner's previous use of forestry assistance, either public assistance or private consultant.
- Landowner's stated intention to harvest timber products in the future.
- Landowner's stated reasons for owning forest land related to production of timber products.

The first category was selected because it obviously and explicitly deals with using technical assistance. The latter two categories were included because of the strong timber and wood products orientation of participants in assistance programs. Although the specific questions were linked to the assistance program, each stands alone and may be used to assess other issues. Responses to selected questions from these areas were used to represent the dependent (Y) variables, the variables to be

predicted in this research. Note that these variables were not modeled to predict behavior of landowners who responded to the original survey. Rather the purpose is to model responses from previous participants as an indication of behavior of other landowners.

The questionnaire also contained information about landowners and their forest holdings that would be useful in predicting the key indicators of landowner response to assistance:

- Ownership-size class.
- Timber-size class.
- Previous timber harvest activity.
- Landowner age.
- Landowner education.
- Landowner income.
- Landowner occupation.
- Geographical location of forest land.

This list represents potential independent (X) variables.

Two analytical techniques are particularly well suited to the type of prediction needed in this research—the discriminant function and the logistic function. The difference can be illustrated with the question: Will a specific landowner use technical forestry assistance? Given measurements on the independent (X) variables reflecting landowner characteristics, the discriminant function will predict an outcome (the Y) as being either yes or no. Given the same set of measurements, the logistic function will predict the numerical probability. For example, given a set of landowner characteristics, the discriminant function might predict an outcome of "no," will not use assistance; whereas the logistic function might predict the outcome as 0.15, a 15 percent probability that assistance will be used. The logistic function, sometimes referred to as a "logit model," was judged more suitable for this study.

The logistic function resembles a typical multiple linear regression function, but also differs from it. Three aspects warrant mention. First, while the multiple regression function is a linear function, the logistic function is nonlinear. Second, in the case of multiple regression, the statistical model is of the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i \qquad (1)$$

The regression coefficients (β's) show the linear relationship between the independent variables (X_i) and the dependent variable (Y). A logistic regression model instead estimates a probability. This is done by means of the ratio of natural logarithms:

$$P(E) = \frac{e^{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i}}{1 + e^{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i}} \qquad (2)$$

All symbols are as before, except for P(E), the probability of an event, which lies between 0.0 and 1.0; and "e", the base of natural logarithms, which is approximately 2.718. Third, interpretation of the regression coefficients is different. In the case of multiple linear regression, each coefficient (β_i) can be directly interpreted as the effect of a unit change in X_i on Y, when all other variables are held constant. For the logistic model, β_i represents the effect of a unit change in X_i on the exponent of "e". This attribute makes it somewhat more difficult to interpret coefficients. For a more complete discussion of the logistic function, see Pindyck and Rubinfeld (ch. 10, 1981).

Study data were analyzed by means of the Stepwise Logistic Regression feature of BMDP Statistical Software (Dixon 1981). Each dependent variable was transformed to take on only 0 or 1 values. All independent variables were formulated in terms of categories or classes. For example, the variable, landowner age, has three classes, one of which is 65 years and older. All dependent variables together with their class designations are shown later as part of table 2.

Initial model construction involved unrestricted entry and exit of variables until no additional variable could achieve statistical significance, based on the F statistic with $\alpha = 0.10$. Many sets of observations (cases) had "missing" values for one or more independent variables (some respondents did not answer some questions in the original questionnaire). Because the computer program automatically excluded any case with missing values, effective sample size was frequently reduced to about 300. Final model construction involved refitting all data to models containing only the statistically significant variables identified in initial model construction; the stepwise procedure was not used. This increased effective sample size from 300 to between about 350 and 500 cases.

Traditional statistical measures of model goodness, such as R^2, are not very useful to assess logistic regression models. Rather, their overall ability to correctly predict the event being studied, for example as reflected by Chi-square, is a more useful measure. This aspect will be discussed along with other study results.

RESULTS

This study estimated four logistic regression models whose dependent variables had been identified as being important to administration and implementation of the Private Forestry Assistance program in Montana. Estimates for dependent variables should be interpreted as the probability of a landowner behavior event occurring (P[E]). The four landowner events studied pertain to:

- E1. **Using** the services of a Private Forestry Assistance (**PFA**) forester.
- E2. **Using** any technical assistance services, either from a PFA forester or a private forestry consultant.
- E3. **Harvesting** timber from forest land at any future time.
- E4. **Currently** owning forest land either for **timber** production (income from the growth and sale of timber or other forest products) or for farm or domestic use (source of forest products for own use—firewood, fenceposts, etc.).

Logistic Models

Although the specific details of the four logistic regression models are different, the form of the results and their interpretation process are identical. Additionally, some models are sufficiently complex so that narrative presentation is too cumbersome. For these reasons, results for only the first (E1) model, using a PFA forester, will be presented. But the discussion also applies to the other models. Data needed to interpret those models will be displayed in tables and figures.

The likelihood of a forest landowner using the services of a PFA forester was found to significantly vary as a function of size of ownership and region of location. The region variable has three class categories: northwest, southwest, and central, as displayed in figure 1. The ownership size variable also has three classes: 40–159 acres (16.2–64.3 ha), 160–639 acres (64.8–258.6 ha), and 640 or more acres (259.0 or more ha). Other factors (tree size, owner age, income, etc.) probably influence use of PFA, but did not increase predictability by a statistically significant amount over ownership size and region.

Overall, only about 18.8 percent of western Montana forest landowners have used the services of a PFA forester, but substantial differences exist between regions and size-classes. Table 1 shows the effect of these differences and the probability of using the PFA program. There is a pronounced regional effect wherein, regardless of size-class, landowners in the southwest region have a higher probability of use than in the northwest and both greatly exceed the central region. Similarly, owners in the middle size-class, independent of region, have the highest probability of use; the smallest size-class has the lowest. Consequently, middle size-class owners from the southwest region have the highest probability of use, while central region owners in the smallest size-class have the lowest use probability.

Table 1.—Probability of Montana forest landowner using services of a PFA forester, by region and size-class

Size-class	Region		
	Northwest	Southwest	Central
Acres			
40-159	0.127	0.150	0.037
160-639	.271	.311	.089
640 +	.264	.303	.086

The probabilities of using the PFA program (E1) are easily displayed. Only two independent variables were statistically significant, each with three classes or categories. Results could be displayed in a 3 X 3 table. But those are the only easily displayed results. Table 2 shows all logistic regression models and information pertaining to the statistically significant variables. Rather than presenting a series of complex tables to display results, the process of computing the probabilities shown in table 1 from the data for the equivalent model (E1) in table 2 will be fully explained. Probabilities analogous to those in table 1 could easily be computed for any model, as desired by the reader.

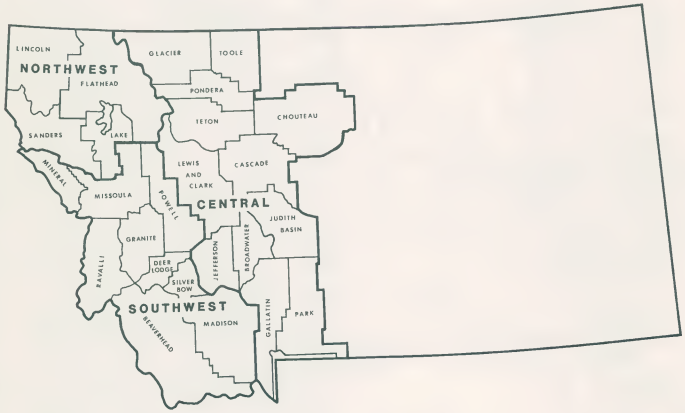

Figure 1.—Three geographical regions within Montana.

Table 2.—Partial exponents for logistic regression models

Variable or factor	Classes or categories	E1 Using PFA	E2 Using any	E3 Harvest any	E4 Current timber
Constant	—	−1.694	−2.487	1.801	−1.667
Ownership size	40-159 acres	−.614	−.564	−.585	—
	160-639 acres	.326	.259	.338	—
	640 + acres	.288	.305	.247	—
Timber size	≤5 inches	—[1]	—	—	−.002
	5-9 inches	—	—	—	−.316
	≥9 inches	—	—	—	.318
Prior harvest	Yes	—	.552	.859	1.197
	No	—	−.552	−.859	−1.197
Age	44 years and under	—	—	.484	—
	45-64 years	—	—	.446	—
	65 years and older	—	—	−.930	—
Education	1-8 years	—	—	—	−.400
	9-12 years	—	—	—	1.003
	Post-high school	—	—	—	−.646
	Bachelors degree	—	—	—	.701
	Postgraduate	—	—	—	−.659
Occupation	Professional	—	1.790	—	.580
	Administrative	—	.473	—	.232
	Sales	—	.781	—	−1.759
	Crafts	—	1.185	—	−1.021
	Operator	—	.240	—	−.573
	Laborer	—	−8.092	—	.069
	Farmer/Rancher	—	1.404	—	.636
	Retired	—	.936	—	−.261
	Other	—	1.285	—	2.100
Region	Northwest	.380	.465	—	.965
	Southwest	.573	.445	—	−.030
	Central	−.953	−.910	—	−.935

[1]Dashes (—) indicate variable as not statistically significant.

Data contained in table 2 are a condensed form of the logistic regression models, the coefficients and associated design matrixes. They constitute the contribution of each category to the logistic model. Consider the probability of 0.311 shown in table 1 for southwest region owners in the 160-639-acre (64.8–258.6-ha) size-class. Refer now to the data in table 2 for the appropriate variable category pertaining to the E1—Using PFA model:

Constant..... (−1.694)
Size—160–639 acres ..... (0.326)
(64.8–25.8.6 ha)
Region—southwest ..... (0.573)

The numbers (−1.694, 0.326, and 0.573) are used to quantify $\hat{Y}$ in equation 2:

$$P(E1) = \frac{e^{\hat{Y}}}{1 + e^{\hat{Y}}}$$

Simply determine $\hat{Y}$ as the sum:

$$\hat{Y} = -1.694 + 0.326 + 0.573$$
$$= -0.795$$

Hence:

$$P(E1) = \frac{e^{-0.795}}{1 + e^{-0.795}}$$
$$= 0.311 = 31.1 \text{ percent}$$

Similarly, to estimate the probability of using PFA by central region owners in the smallest size-class:

$$P(E1) = \frac{e^{\hat{Y}} = -1.694 + (-0.614) + (-0.953) = -3.26}{1 + e^{\hat{Y}} = -3.26}$$
$$= 0.037 = 3.7 \text{ percent}$$

Probabilities for other events, E2-E4, are determined by using the procedure just described. It is important that each significant variable have a coefficient in the summation.

For some purposes, it may not be necessary to calculate probabilities with great precision. An approximation will be sufficient. Table 3 provides a listing of $\hat{Y}$ values together with the associated probability of event values. Consider the case of 160–639-acre (64.8–258.6-ha) owners in the southwest region where $\hat{Y} = -0.795$. Inspection of table 3 shows −0.8 to be the closest $\hat{Y}$ value; its associate P(E) is 0.310 which corresponds to 0.311 shown above. Since all probability values can be calculated exactly, use of table 3 is optional.

Table 3.—Probability of events for corresponding values of $\hat{Y}$

$\hat{Y}$	P(E)
-10.0	0.000
- 8.0	.000
- 6.0	.003
- 5.5	.004
- 5.0	.007
- 4.5	.011
- 4.0	.018
- 3.5	.029
- 3.0	.047
- 2.5	.076
- 2.0	.119
- 1.8	.142
- 1.6	.168
- 1.4	.198
- 1.2	.232
- 1.0	.269
- 0.8	.310
- 0.6	.354
- 0.4	.401
- 0.2	.450
0.0	.500
0.2	.550
0.4	.599
0.6	.646
0.8	.690
1.0	.731
1.2	.769
1.4	.802
1.6	.832
1.8	.858
2.0	.881
2.5	.924
3.0	.953
3.5	.971
4.0	.982

Data contained in table 2 can also be used less analytically. The numbers themselves indicate relative importance in determining the probability of an event occurring. The bigger the number, the larger the effect on probability. Consider the E1 model. The smallest numbers in table 2 are associated with the 40–159-acre (16.2–64.3-ha) size-class and the central region. Both have relatively large negative values (–0.614 and –0.953 respectively). Table 1 shows these categories have lower probabilities and when combined constitute the lowest probability. Conversely, the highest probabilities in table 1 are for the middle size-class and the southwest region, variable categories with the largest values in table 2. Table 2 values should be compared within a column, not between columns. Table 2 values contribute to the size of the exponent ($e^{\hat{Y}}$); therefore effect on probability is not proportional to size.

The quality of a logistic regression model is determined by its ability to predict outcomes correctly. Moreover, the goodness of predicted probabilities can be verified only in the context of a large number of prediction opportunities. Although the probabilities can be applied to a specific forest landowner, evaluation of the probabilities estimated by logistic regression is best done by reference to the combined outcomes over many individuals. Table 4 compares predicted and actual percentages of landowners using the PFA program, both derived from the study data base.

Table 4.—Actual and predicted participation (percentage) in PFA programs by size-class and region

Participation		Size-class	Region	Sample size
Actual	Predicted			
----------Percent----------		Acres		
5.7	3.7	40 – 159	Central	35
6.5	8.9	160 – 639	Central	31
8.8	8.6	640 +	Central	34
12.2	12.7	40 – 159	Northwest	90
14.6	15.0	40 – 159	Southwest	82
26.8	27.1	160 – 639	Northwest	82
27.9	26.4	640 +	Northwest	43
28.6	30.3	640 +	Southwest	42
33.3	31.1	160 – 639	Southwest	45

Consider the case of northwest region landowners in the 40–159 acre (16.2–64.3 ha) size-class. The logistic regression model predicted that 12.7 percent of the 90 landowners would use the PFA program. In fact, 11 of the 90, amounting to 12.2 percent, of the landowners did. Comparisons between predicted and observed participation for the other logistic regressions, E2-E4, are very similar to those shown for E1, but are too complicated to present here. The E1 logistic regression model yielded the best predictions; the E2 model the worst predictions, based on a Chi-square analysis.

Cut-off Points

Although the overall accuracy of the logistic regression models are revealed in the context of a large number of landowners, their application in forestry assistance is to set priorities for the assistance program. A rule or cut-off point must be established by which a class of landowner (or classes) is judged a likely (good) or unlikely (bad) prospective client for the assistance program. One must establish a probability level (P[E]) above which an associated class of landowner (or classes) is judge to be "likely" clients, below which judged "unlikely." In reality the cut-off point would be used as a guideline, a "screening" device to separate the likely from the unlikely prospects. The PFA forester can then focus time and attention on the likely prospects, deemphasizing or screening out the unlikely.

Unfortunately, although individual landowners within a class have similar characteristics (region and ownership size), they do not always behave alike. Any cut-off point will result in errors. A trade-off exists between correctly identifying those landowners for which an event (using PFA services) will occur and correctly identifying those for which the event will not occur. (This problem is analogous to the statistical problem of a Type I and

Type II error.) Figure 2 graphically depicts these trade-offs for each of the four logistic models being presented. Shown in the frame pertaining to the E1 model, a lower cut-off point (say P(E1) = 0.05) will correctly identify all individuals that did use PFA forester services (coded "Using PFA"). But it fails miserably at identifying those that did not (coded "Not Using"). If the cut-off point were set at P(E1) = 0.05, then any class of landowners where the associated P(E1) were greater than 5 percent would be judged as likely clients. The cut-off point would correctly identify about 95 percent of the users, but only about 10 percent of the nonusers. That

Figure 2.—Cut-off point analyses for logistic regressions

is, about 90 percent of the nonusers would be mistakenly identified as users.

The low cut-off level screens nobody and leads to the conclusion that virtually everyone will use PFA services. On the other hand, a high cut-off level leads to the conclusion that nobody will use the services of a PFA forester. Figure 2 shows that if the cut-off level were set anywhere between a probability value (P[E1]) of 15 to 25 percent, about 67 percent of the users and about 62 percent of the nonusers would be correctly identified. Below that level users would be better identified, but many nonusers would be misidentified as likely users. Conversely, above that level, likely users would increasingly be misidentified as likely nonusers.

Cut-off points must be decided for all logistic regressions (E1-E4) presented in this paper. The probability level selected should relate to the consequences (or costs) of misidentification. For example, if it is very important to correctly identify all likely PFA program users and it is not particularly costly to identify nonusers as users, a low cut-off point is appropriate. Alternatively, if the capability to provide assistance is limited such that correct identification of unlikely clients is critical, a relatively high cut-off point is appropriate. The four frames of figure 2 provide the information for determining cut-off points for all (E1-E4) logistic regression models.

DISCUSSION AND APPLICATIONS

This paper presents results from logistic regression models pertaining to landowner use of the forestry assistance program provided by the Montana Division of Forestry, Department of State Lands. Unfortunately, the available data base did not exactly address that topic. Several surrogate models were developed, each of which only partially related to desired topic. A reasonably simple model, E1—Using PFA, was used to illustrate how questionnaire-type data can be easily converted to probability estimates. The interpretive approach shown for that model should be applied to the other models, as dictated by the user needs. Additionally, users such as the Montana Division of Forestry will have to evaluate these results and develop guidelines for application. Questions must be addressed. For example: Which model or models (E1-E4) should be emphasized and what cut-off points are appropriate?

Assume, for example, that a judgment is made to use the E1—Using PFA as the primary model and E4—Current Timber as the secondary model. Further assume such shortage of funds that it is more critical to screen-out unlikely clients than to correctly identify all likely clients. A relatively high cut-off point would be appropriate. If figure 2 were used to set the cut-off point at 0.28, about 85 percent of the unlikely clients (nonusers) would be screened, but only about 30 percent of the likely clients (users) would be identified. That a higher percentage of likely clients was not identified might be judged acceptable under circumstance of an extreme funding shortage. Table 1 shows that only southwest region landowners in the two largest size-classes meet that standard.

If further restrictions are needed, the E4—Current Timber model could be used analytically, as was the E1 model, or nonanalytically. Inspection of the E4 portion of table 2 for the largest exponents, shows that landowners that have harvested timber, that have 9 to 12 years of education, and that have an "other" occupation will have a relatively high probability of owning forest land for timber production.

The procedure described offers a system for establishing the top priority landowner group wherein assistance would be targeted. Subsequent analysis could be used to develop a more comprehensive priority listing, as needed. The technique described in this report is not highly refined, but it does illustrate the application of logistic regression to the problem. If the general approach is deemed useful, the data base could readily be improved.

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Four logistic regression models were developed from questionnaire data obtained from forest landowners. The models were designed to assist the Montana Division of Forestry to rate clients for the forestry assistance program. Interpreting and applying results is discussed. Basic data are presented.

KEYWORDS: forestry assistance, forest landowners, logistic regression, logit analysis

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